MOTOROLA
test equipment

SIGNAL GENERATOR

R-1201A

MP MASTER
MA36308

68-81069A39-0

MOTOROLA

68-81069A39-0

MOTOROLA INC.
Communications Division Parts Dept.
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R-1201A POWER REQUIREMENTS

FROM EITHER 100V, 115V, 120V, 200V, 230V, or 250V

An important feature of thesignal generator is that as long as the R-1201 is plugged into a live AC outlet and even though the unit is turned "Off," the oscillator is being powered. This is most important as it results in a stable, accurate and low aging characteristic. Refer to table below.

With Power Switch "Off"

OSCILLATOR	100-125V AC LINE	200-250V AC LINE
TCXO	OSC. OFF	OSC. OFF
STD. OSC.	OSC. ON	NOT RECOMMENDED
HI-STAB.	OSC. ON	OSC. ON

The model R-1201A is supplied with a 1.5 ampere Slo-Blow Fuse (100-125V Operation). If (200-250V Operation) is configured, the 1.5 ampere fuse should be replaced with a .75 ampere Slo-Blow fuse to adequately protect the service monitor.

After insuring that the proper fuse and power plug is installed, connect the power calbe between the rear panel AC power connector and the local power source.

Place the front panel PWR switch to its "ON" position and note that the pilot lamp illuminates.

VOLTAGE SELECT JUMPER PLUG (P7) PLUG CONFIGURATIONS

LINE VOLTAGE	JUMPER CONNECTIONS PINS	PINS	PART NUMBER	WIRE COLOR
100V	2-8	1-3-7	RPX-4116A	Brown
115V	2-8	1-4-6	RPX-4117A	White
125V	2-8	1-5-9	RPX-4118A	Red
200V	1-7	3-8	RPX-4119A	Orange
230V	1-4	6-8	RPX-4120A	Yellow
250V	1-5	8-9	RPX-4121A	Green

The AC line voltage is connected directly to connector A3J8 pins 10 and 12 to supply AC to the oven of the optional high stability oscillator when installed, thus allowing the oscillator oven to remain on whenever the Signal Generator is connected to an AC line source. When the optional high stability oscillator is installed, a PC mounted 115-230V switch S1 is provided to allow for the proper AC line voltage setting.

Switch (S-1) is accessable when the top cover is removed. It is located along the right hand side about half way back. See figure 7-55 and 7-56 in the R-1201A manual.

Jumper Plug (P7) is located on the left side toward the rear.

NOTE: Since the AC line voltage is connected directly to connector A3J8 pins 10 and 12, the R-1201A with the standard oscillator should NOT be connected to a 200-250VAC source without making the modifications listed below.

Even though the standard oscillator is not recommended for 200-250VAC operation, the R-1201A can be wired to make it possible. However, the oven heater will not be on when the power switch (S-3) is turned off.

Modification procedure to operate standard oscillator from a 200-250VAC source:

1. Remove the lead from pin 12 of plug P8.

2. Splice the lead included with 200-250VAC conversion kits with the lead removed from pin 12 of P8. Heat shrink tubing can be applied over the splice.

3. Splice the other end of the added lead to the jumper from pin 8 of plug (P7) leaving the jumper connections intact.

R-1201A's with a serial number smaller than 14030-X have a AC line voltage select plug (P7) that is physically smaller in size than the newer units.

The new plug is approximately 7/8" square. The old plug is approximately 9/16" square. The old plug is no longer available, but the jumpers can be reconfigured per the table above.

CHAPTER 1
GENERAL INFORMATION

1.1 INTRODUCTION

This instruction manual contains the operation and maintenance information for the Model R-1201A Signal Generator. The contents of this manual is divided into eight chapters. Chapter 1 provides the general description and specifications for the Signal Generator. Chapter 2 includes the receiving inspection, preparation for use and initial turn-on instructions. Chapter 3 describes the operation of the Signal Generator as to the use of the various controls, connectors and indicators. Chapter 4 provides the principles of operation at the overall functional level and is followed up with a detailed circuit analysis of each functional sub-assembly, and Chapter 5 contains the alignment and calibration procedures. Chapter 6 contains the replaceable parts lists and Chapter 7 the schematics, component location and assembly drawings.

1.2 DESCRIPTION

The Model R-1201A Signal Generator is a frequency synthesizer that generates fundamental (non-harmonic) signals from 100 Hz to 999.9999 MHz in 100 Hz discrete steps. Selection of AM and FM modulation of the output is provided, either by an internal 1 kHz source or by an external dc to 20 kHz source. The internal and external modulation features may be used simultaneously as well as the AM and FM modes. The internal 1 kHz modulation source is available as a Front Panel BNC output, this feature provides many uses, including modulation drive for a FM transmitter when adjusting frequency deviation. A CW mode is also provided to allow generation of an unmodulated carrier.

The Signal Generator's output is continuously variable from 0.1 μV to 1 Vrms (-127 dBm to +13 dBm) by a Front Panel 20 dB vernier control and a six step attenuator. The Signal Generator's output is protected against input or output overloads of over ±10V peak, with Front Panel reset.

The Signal Generator is normally referenced to an internal 1 MHz oscillator having a stability of $\pm 7 \times 10^{-9}$ parts per day, or may be optioned with a TCXO or high stability oscillator. A Rear Panel BNC connector is provided to monitor the 1 MHz reference or connect an external 1 MHz reference from a frequency standard.

1.3 SPECIFICATIONS

Table 1-1 lists the specifications and leading particulars of the Model R-1201A Signal Generator.

TABLE 1-1 SPECIFICATIONS

FREQUENCY	
Range:	100 Hz to 999.9999 MHz.
Display:	7-digits individually selectable.
Resolution:	100 Hz steps.
Accuracy:	Equal to accuracy of reference oscillator used.
OUTPUT (Leveled into 50 ohms)	
Range:	0.1V to 1 Vrms (-127 dBm to +13 dBm).

TABLE 1-1 SPECIFICATIONS (Cont'd)

Flatness:* (@.5 µV and 25°C)	Typical	Guaranteed
100 kHz - 250 MHz	±.5 dB	±1.0 dB
250 MHz - 55 MHz	±.7 dB	±1.5 dB
550 MHz - 1 GHz	±1.0 dB	±2.0 dB

Accuracy:**		STEPS	
	0 dB	20,40,60,80 dB	100,120 dB
100 kHz - 550 MHz	Uncalibrated	±1.0 dB	±1.5 dB
500 MHz - 1 GHz	Uncalibrated	±1.5 dB	±2.0 dB

Temperature Variance:	±0.5 dB additional over 0°C -55°C.
SPECTRAL PURITY	
Harmonics:	≥-25 dBc.
Non-Harmonic (Spurious):	
100 kHz - 110 kHz	≥-40 dBc.
110 kHz - 1 GHz	≥-50 dBc.
Noise: Residule FM (.1 to 3 kHz BW)	
100 kHz - 500 MHz	≤50 Hz rms.
500 MHz - 1 GHz	≤100 Hz rms.
Residule AM (.1 to 3 kHz BW)	≤.1% at +13 dBm.
1 Hz BW noise at 50 Hz offset:	
100 kHz - 500 MHz	≤-103 dBc.
500 MHz - 1 GHz	≤ -97 dBc.
Attenuator:	20 dB Variable. 20 dB steps over 6 ranges.
Output Impedance:	50 ohms, nominal.
Output Connector:	Type N.
Output Modes:	AM,FM,CW.
Amplitude Modulation (AM):	
Range:	0 to 90% at output setting of +7 dBm on the vernier attenuator.
Rate:	0 to 10 kHz.
Internal Rate:	1 kHz fixed.
Pulse Response:	±40 µs transistion times.
Display Accuracy:	3% of reading. ±3% full scale. 1% resolution.

*Variance of output as a function of frequency at fixed output setting.
**Additional one-time inaccuracy when switching from range to range.

TABLE 1-1 SPECIFICATIONS (Cont'd)

Distortion @1 kHz rate:	
at 30% modulation	.6% typical, 1.2% maximum.
at 70% modulation	.5% typical, 2.5% maximum.
at 90% modulation	1% typical, 5% maximum.
External Input:	2V peak for 100%.
Connector:	BNC.
Impedance:	600 ohms.
Incidental FM at 30% AM, 1 kHz:	≤90 Hz.
Modes:	Internal, external or both simultaneously
Frequency Modulation (FM)	
Internal Rate:	1 kHz fixed.
Deviation:	0 to 20 kHz peak.
Rate:	dc to 15 kHz.
Pulse Response:	40 µs transistion times.
Display Accuracy:	±3% of rdg., ±200 Hz, 100 Hz resolution.
External Input:	2V peak for 20 kHz peak deviation.
Connector:	BNC.
Impedance:	600 ohms.
Distortion	
at 20 kHz Deviation, 1 kHz rate:	1.2%
at 20 kHz Deviation, 15 kHz rate:	2.6%.
at 10 kHz Deviation, 15 kHz rate:	1%.
Incidental AM at 20 kHz, Deviation, 1 kHz rate:	1%.
GENERAL	
Time Base: Standard Oscillator (Octal Base)	
Aging Rate:	$\pm 7 \times 10^{-9}$/day. $\pm 2.6 \times 10^{-6}$/year.
Temperature Stability:	-10 to +55°C. $\pm 3 \times 10^{-9}$/°C.
TCXO Oscillator (T Option)	
Aging Rate:	$\pm 1 \times 10^{-6}$/year on an exponential curve.
Temperature Stability:	0 to +55°C. $\pm 5 \times 10^{-7}$.
High Stability Oscillator (X Option)	
Aging Rate:	$\pm 3 \times 10^{-9}$/day. $\pm 1.1 \times 10^{-6}$/year.
Temperature Stability:	-15 to +60°C. $\pm 2 \times 10^{-10}$/°C.

TABLE 1-1 SPECIFICATIONS (Cont'd)

Internal 1 kHz Output	
Level	0 to 2V peak into 50 ohms.
Distortion:	≤1%.
Connector:	BNC.
Output Protector:	
Trip:	Approximately 10V peak dc & ac to 1 GHz.
Reset:	Pushbutton switch with trip indicator.
RF Leakage:	At level not to increase IF output test point of a Motorola A04FMC pager (.2 µV sensitivity) by more than 0.5 dB when placed 12 inches (30.5 cm) if front of unit developing .5 µV output into a shielded termination.
Power Required:	100-130 Vac, 200-260 Vac rms, 48-65 Hz, plug programmable, 75 watts maximum.
Display:	
Modulation (3-1/2 digit LED):	AM in %, FM in kHz with LED annunciators.
Indicators (LED):	LOCK - frequency. LEVEL - rf output. MODE - AM,FM,CW.
Temperature:	
Storage:	-55°C to +85°C (-67°F to 185°F).
Operating:	-12°C to +55°C (-10°F to 131°F).
Weight:	18.2 kg (40 lbs).
Dimensions:	
Height:	13.3 cm (5-1/4 inches).
Width:	42.6 cm (16-3/4 inches).
Depth (with cover):	46.6 cm (18-3/4 inches).

CHAPTER 2
INSTALLATION

2.1 INTRODUCTION

This chapter provides procedures for the receiving inspection, initial installation, and initial turn-on of the Model R-1201A Signal Generator. Reshipment instructions are also included, should it become necessary to return the Signal Generator for service or repair.

2.2 INCOMING RECEIVING INSPECTION

Prior to accepting the Signal Generator from the shipper, inspect the condition of the shipping container for any indication of external freight damage. Any sign of such damage must be noted by both the shipper and the receiving customer, and should be reported to the carrier.

Immediately following removal of the Signal Generator from its shipping carton, inspect it for possible physical damage incurred during shipment. Should any damage be noted, notify your Motorola representative -- DO NOT USE THE SIGNAL GENERATOR UNTIL INSTRUCTED TO DO SO BY THE REPRESENTATIVE.

2.3 INSTALLATION CONSIDERATIONS

The Model R-1201A does not require forced air cooling and no internal blower is installed. Installation, however, should be such as to allow normal circulation of the flow of air around its external surfaces, especially the Rear Panel mounter heat sink. Access to the Rear Panel controls, connectors and adjustment ports require clearance, and if the Signal Generator is to be mounted, proper clearance for Rear Panel operation and cable routing must be considered.

2.4 POWER REQUIREMENTS AND INITIAL TURN-ON

The Model R-1201A operates from 110,115,125,200,215,230,240 or 250 Vac ±10%, 48 to 65 Hz and requires 75 watts. A standard three-conductor power cable which, when plugged into an appropriate power receptacle, grounds the chassis to protect operating personnel from certain electrical hazards. Whenever the power cable is mated to a two-conductor outlet, an adapter (properly installed) to provide grounding of the chassis will provide the same protection.

Check the local power source and configure the internal power supply jumper plug for the appropriate line voltage. Refer to Table 2-1 for the jumper plug connection configuration.

After ensureing that the proper fuse is installed in the Rear Panel fuse holder, connect the power cable between the Rear Panel ac power connector and the local power source. Press the Front Panel POWER pushbutton switch and verify that it illuminates.

NOTE

The Model R-1201A is supplied with a 1.5 ampere Slo-Blo fuse (100-125V operation). If 200-250 operation is configured, the 1.5 ampere fuse should be replaced with a .75 ampere Slo-Blo fuse to adequately protect the Signal Generator.

TABLE 2-1 P7 PLUG CONFIGURATIONS

LINE VOLTAGE	JUMPER CONNECTIONS PINS	PINS	PART NUMBER	COLOR CODE
110	2-8	1-3-7	05767801	Brown
115	2-8	1-4-6	05767802	White
125	2-8	1-5-9	05767803	Red
200	1-7	3-8	05767804	Orange
215	1-7	6-8	05767809	Gray
230	1-4	6-8	05767805	Yellow
240	1-5	6-8	05767807	Violet
250	1-5	8-9	05767806	Green

2.5 INCOMING CONFIDENCE CHECK

Prior to packaging the Signal Generator for shipment, extensive operational, alignment and calibration procedures were performed by our test and QA departments.

To satisfy the electronic integrity of the Signal Generator at your receiving bench the following incoming confidence check should be performed.

1. Perform the appropriate power application and initial turn-on procedures as outlines in paragraph 2.4.

2. Ensure that the Rear Panel EXT-CLOCK-INT slide switch is in its INT position.

3. Press the POWER pushbutton indicator (PBI) switch.

4. Set the OUTPUT LEVEL control to its .5V (+7 dBm) position and the STEP ATTENUATOR switch to its .1V (-20 dB) position. Connect an Oscilloscope to the RF OUT N connector to allow monitoring of the Signal Generators output. Use a 50Ω termination.

5. Press the MODULATION MODE FM PBI switch and verify that the FM-kHz, LOCK and LEVEL annunciators illuminate.

6. Place the MOD SOURCE switch to INT and "dial-up" a frequency that is within the bandwidth of the Oscilloscope on the 7-digit FREQUENCY-MHz switch.

7. Slowly rotate the INTERNAL MODULATION control from its fully CCW position (MIN) and verify that the Display indicates a deviation from 00.0 to at least 20.0. Verify an output signal on the Oscilloscope by selecting a 20 kHz RF output frequency and observing that frequency modulation occurs.

8. Press the MODULATION MODE AM PBI switch and verify that the AM-% LOCK and LEVEL annunciators illuminate.

9. Slowly rotate the INTERNAL MODULATION control from its fully CCW position to its fully CW position (MAX), and verify that the Display indicates a modulation percentage from at least 10 to 90%. Verify an output signal on the Oscilloscope having a 1 kHz AM modulation that is adjustable from 10% to 90%.

10. Place the MOD SOURCE switch to its EXT position. Connect a coax cable from the 1 kHz OUT BNC connector to the EXT MOD BNC connector. Press the MODULATION MODE FM PBI switch. Repeat steps 7 through 9 using the EXTERNAL MODULATION control in place of the INTERNAL MODULATION control.

11. Press the MODULATION MODE CW PBI. Verify an unmodulated CW output on the Oscilloscope.

12. Disconnect the Scope from the RF OUT connector and connect a 1 GHz Frequency Counter to the RF OUT connector (drive the Frequency Counters time base from the Model R-1201A Rear Panel 1 MHz OUT BNC connector). Verify the output frequency for each of the following FREQUENCY-MHz switch settings.

010.0000
101.1111
110.0000
222.2222
444.4444
888.8888
999.9999

2.6 PREPARATION FOR RESHIPMENT

When the Signal Generator is to be repackaged for shipment use the original packing materials, package in accordance with MIL-P-116 and MIL-E-17555E specifications or repackage using the following general instructions.

1. Attach a tag to the Signal Generator indicating the model number, serial number, name and address of the owner, and a summary of the service or repairs required.

2. Wrap the Signal Generator in heavy paper or plastic prior to placing it into the shipping container.

3. Select a strong carton or wooden box as a shipping container.

4. Use an adequate layer of shock-absorbin material on all sides of the Signal Generator and protect the Front Panel with additional layers of cardboard. Ensure that there is no movement of the assembly within the container.

5. Seal the package with strong tape or metal bands.

6. Mark the shipping container *"FRAGILE - DELICATE INSTRUMENT"* and place handling symbols to ensure proper handling.

7. Be certain that all correspondance refers to full nomenclature (model and serial number).

CHAPTER 3

OPERATION

3.1 INTRODUCTION

This chapter describes the general operation of the Model R-1201A Signal Generator. The Front and Rear Panel controls, indicators and connectors are depicted and described as to their function and effect on the Signal Generators operation.

3.2 FRONT PANEL CONTROLS, INDICATORS AND CONNECTORS

Figure 3-1 depicts the Front Panel of the Model R-1201A Signal Generator, and Table 3-1 describes these controls, indicators and connectors as to their function and operational use.

TABLE 3-1 FRONT PANEL CONTROLS, INDICATORS AND CONNECTORS

INDEX NUMBER	CONTROL, INDICATOR OR CONNECTOR	FUNCTION
1	AM-% annunciator	An LED annunciator that illuminates when the AM mode is selected. Indicates that the 3-1/2 digit display reads % of AM.
2	CW annunciator	An LED annunciator that illuminates when the CW mode is selected.
3	FM-1Hz annunciator	An LED annunciator that illuminates when the FM mode is selected. Indicates that the 3-1/2 digit display reads deviation in kHz of the FM.
4	MODULATION 3-1/2 digit display	A 3-1/2 digit LED numerical display that indicates the % of AM or the frequency of AM deviation in kHz.
5	LOCK annunciator	An LED annunciator that illuminates when the Synthesizer is phase locked to the selected frequency.
6	REMOTE annunciator	An optional LED annunciator that is not used on the R-1201A Signal Generator.
7	LEVEL annunciator	An LED annunciator that illuminates when the RF output is properly leveled. The LED will extinguish if amplitude over-modulation is present or the r-f output protector has tripped.
8	FREQUENCY-MHz selector indicator switch	A seven digit selector-indicator switch that provides the selection and readout of the Synthesizer frequency from 100 Hz to 999.9999 MHz in 100 Hz steps.
9	ATTENUATOR V-dB selector switch	A six step attenuator switch that provides 120 dB of attenuation in six 20 dB steps of the signal at the RF OUT connector.

TABLE 3-1 FRONT PANEL CONTROLS, INDICATORS AND CONNECTORS (Cont'd)

INDEX NUMBER	CONTROL, INDICATOR OR CONNECTOR	FUNCTION
10	OUTPUT LEVEL control	A potentiometer that provides variable adjustment of the r-f output level. The dial is calibrated to provide setting of the output level in Vrms or dBm when used in conjunction with the ATTENUATOR switch.
11	MODULATION INTERNAL control	A potentiometer that controls the internal 1 kHz modulation level. Will adjust the AM from 0% to 90%, and the FM deviation from 0 to 20 kHz.
12	1 kHz OUT connector	A BNC connector that supplies the 1 kHz internal modulation signal as an output. This output is adjustable by the MODULATION INTERNAL control from 0 to 2V peak into a 50Ω load.
13	MOD SOURCE INT-BOTH-EXT selector switch	A 3-position slide switch that allows the selection of the modulation source from the internal 1 kHz, the external dc to 15 kHz source or both, simultaneously.
14	MODULATION EXTERNAL control	A potentiometer that controls the external dc to 15 kHz modulation level. Will adjust the AM from 0% to 90%, and the FM deviation from 0 to 20 kHz.
15	EXT MOD connector	A BNC connector that accepts the dc to 20 kHz external modulation signal, will provide 90% AM or 20 kHz FM deviation with a 2V peak amplitude.
16	POWER pushbutton indicator (PBI) switch	An alternate action PBI switch that allows for the turn-on and turn-off of the Signal Generators line power. Shows blue when power is on.
17	MODULATION MODE FM pushbutton indicator (PBI) switch	An interlocked action switch that allows the selection of the FM mode of operation. Shows blue when FM mode is enabled.
18	MODULATION MODE CW pushbutton indicator (PBI) switch	An interlocked action switch that allows the selection of the CW mode of operation. Shows blue when the CW mode is enabled.
19	MODULATION MODE AM pushbutton indicator (PBI) switch	An interlocked action switch that allows the selection of the AM mode of operation. Shows blue when the AM mode is enabled.
20	RF OUT connector	A type N connector that supplies a 0.1 μV to 1V rms r-f output into a 50Ω load.
21	OVERLOAD RESET pushbutton indicator	A pushbutton indicator which resets the r-f output protector circuit when depressed. Illuminates when the output protector circuit trips.

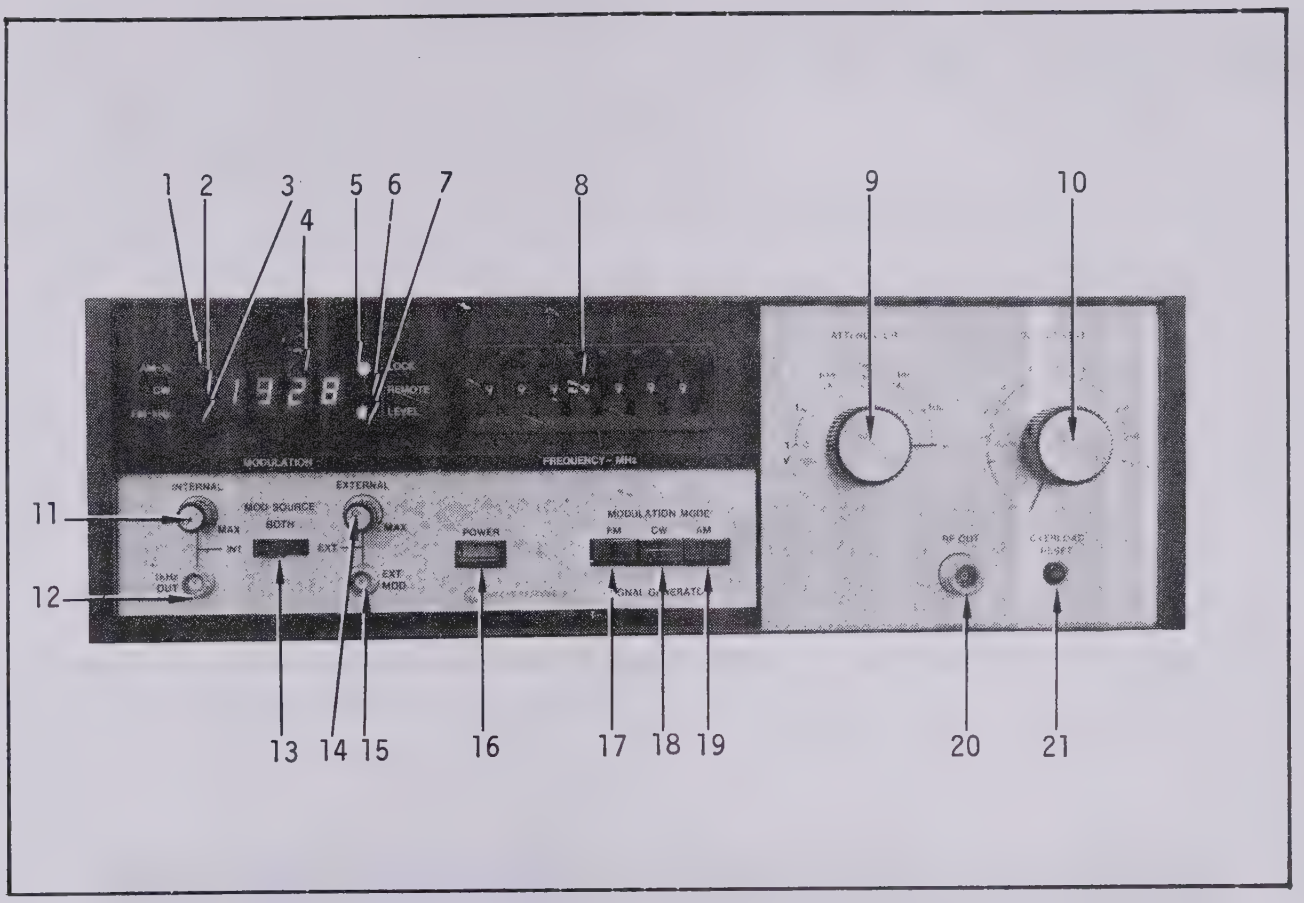


FIGURE 3-1 MODEL R-1201A SIGNAL GENERATOR FRONT PANEL

3.3 REAR PANEL CONTROLS AND CONNECTORS

Figure 3-2 depicts the Rear of the Model R-1201A, and Table 3-2 describes the Rear Panel mounted controls and connectors as to their function and operational use.

TABLE 3-2 REAR PANEL CONTROLS AND CONNECTORS

INDEX NUMBER	CONTROL OR CONNECTOR	FUNCTION
1	CLK SOURCE INT EXT slide switch	A two position slide switch, that selects internal or external reference oscillator for the Signal Generators time base.
2	EXT CLOCK MHz 1 2 5 10 slide switch	A four position slide switch that selects the proper divisor to count down the external clock to 1 MHz.
3	1 MHz OUT connector	A BNC connector that provides a 1 MHz output.

TABLE 3-2 REAR PANEL CONTROLS AND CONNECTORS (Cont'd)

INDEX NUMBER	CONTROL OR CONNECTOR	FUNCTION
4	EXT CLOCK IN connector	A BNC connector that provides the input for an external frequency standard, when the INT CLK SOURCE EXT switch is placed in the EXT position.
5	100-250 VRMS, 48-65 Hz connector	A three pin receptical that provides for connection of the three conductor as line cord.
6	100-125V 1.5A SB 200-250V .75A SB fuse holder	A fuse holder containing a 1.5A SB fuse (100-125 Vac) or a .75A SB fuse (200-250 Vac) to properly protect the Signal Generator when operating from different line voltages.

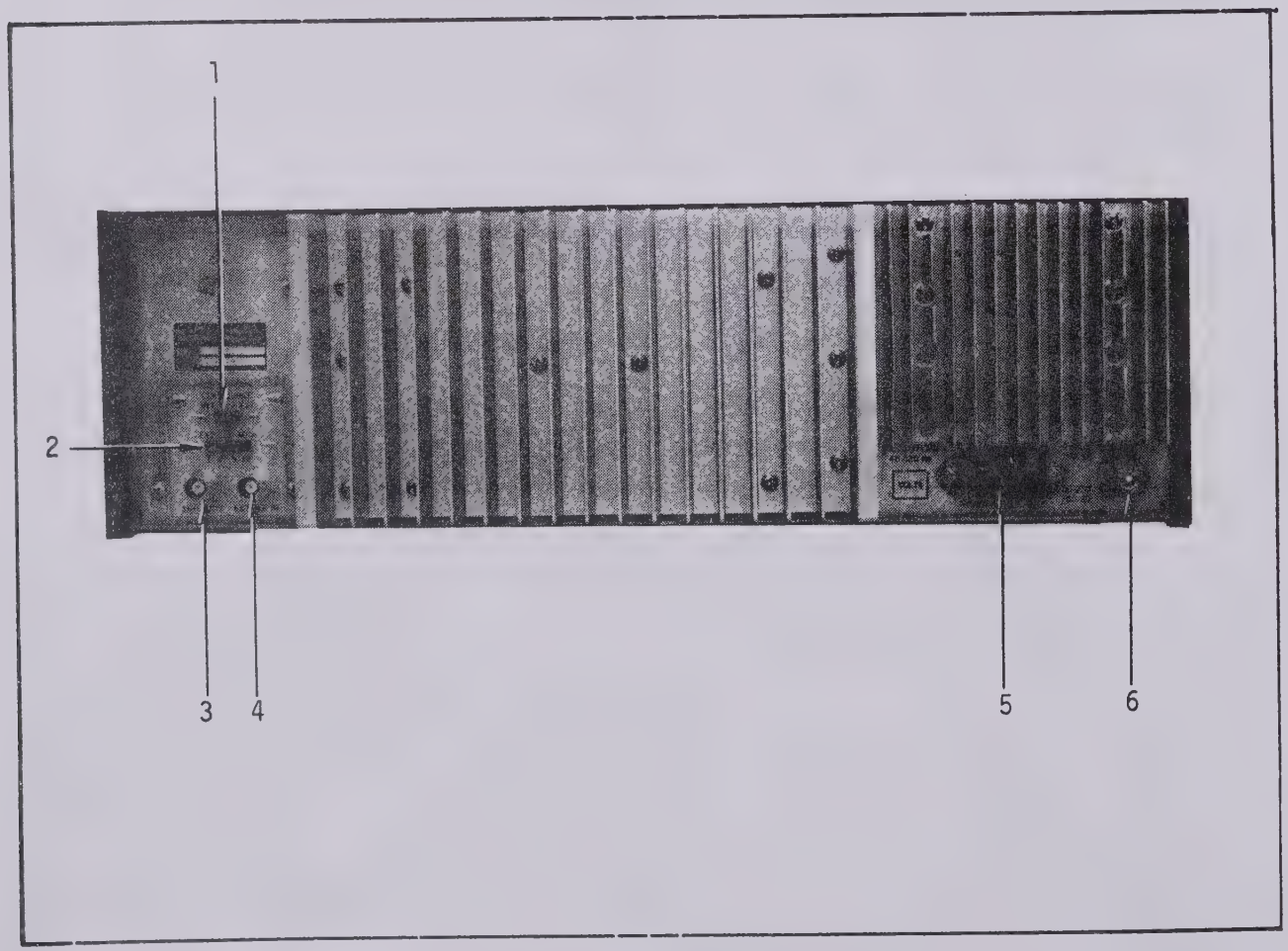


FIGURE 3-2 MODEL R-1201A SIGNAL GENERATOR REAR PANEL

3.4 BASIC OPERATING PROCEDURES

The Signal Generator will generate an r-f signal from 100 Hz to 999.9999 MHz at an output level of 0.1 μV to 1.0 Vrms (-127 dBm to +13 dBm) modulated either in amplitude and/or frequency or un-modulated (CW).

3.4.1 FM Mode Operating Procedure

To generate a FM signal having the desired frequency, modulation characteristics and output level proceed as follows:

1. Select the desired frequency on the 7-digit FREQUENCY-MHz selector switch. Verify that the LOCK annunciator illuminates.

2. Press the MODULATION MODE FM switch and verify the FM-kHz annunciator on the display is illuminated.

3. Select the desired modulation source(s) by use of the MOD SOURCE selector switch, (if external modulation is selected apply a dc to 20 kHz, 0 to 2V peak modulation signal to the EXT MOD BNC connector.

4. Adjust the INTERNAL and/or EXTERNAL modulation controls for the desired deviation as indicated on the 3-1/2 digit numerical display.

5. Select the desired output level by use of the ATTENUATOR and OUTPUT LEVEL controls and verify that the LEVEL annunciator on the display is illuminated.

3.4.2 AM Mode Operating Procedure

To generate an AM signal having the desired frequency, modulation characteristics and output level, proceed as follows:

1. Select the desired frequency on the 7-digit FREQUENCY-MHz selector switch. Verify that the LOCK annunciator illuminates.

2. Press the MODULATION MODE AM switch and verify that the AM-% annunciator on the display illuminates.

3. Select the desired modulation source(s) by use of the MOD SOURCE selector switch, (if external modulation is selected apply a dc to 20 kHz, 0 to 2V peak modulation signal to the EXT MOD BNC connector).

4. Adjust the INTERNAL and/or EXTERNAL modulation controls for the desired percentage (%) of modulation as indicated on the 3-1/2 digit numerical display.

5. Select the desired output level by use of the ATTENUATOR and OUTPUT LEVEL controls and verify that the LEVEL annunciator on the display is illuminated.

3.4.3 CW Mode Operational Procedure

1. Press the MODULATION MODE CW switch.

2. Select the desired frequency on the 7-digit FREQUENCY-MHz selector switch. Verify that the LOCK annunciator illuminates.

3. Select the desired output level by use of the ATTENUATOR and OUTPUT LEVEL controls and verify that the LEVEL annunciator on the display is illuminated.

CHAPTER 4
PRINCIPLES OF OPERATION

4.1 INTRODUCTION

This chapter describes the principles of operation of the Model R-1201A Signal Generator from five perspectives. The overall functional operation at the block diagram level is discussed first, and is referenced to Figure 4-1 Model R-1201A Functional Block Diagram. A detailed description of the Synthesizer Assembly A4 is presented next, and is referenced to Figures 4-2 through 4-12 Functional Block Diagrams located in this chapter and the schematic diagrams that relate to the Synthesizer Assembly located in Chapter 7 of this manual. Next the detailed description of the circuitry contained on the Mother PCB A3, and the Clock Oscillator A5 is presented and referenced to the schematic diagrams that relate to Assemblies A3,A3A1,A3A2,A3A3, A3A4,A3A5 and A5 which are located in Chapter 7 of this manual. And last, the IC's used in the Signal Generator are listed and described as to their characteristics and supported by the IC Data Sheets which provide pinning information, schematic equivalents and detailed characteristics that are unique to the IC device.

4.2 MODEL R-1201A FUNCTIONAL DESCRIPTION

The following functional description is referenced to Figure 4-1 Model R-1201A Functional Block Diagram. The assemblies that make up the Signal Generator configuration are listed by assembly reference designator, along with their functional names and assembly part number in Table 4-1.

TABLE 4-1 MODEL R-1201A ASSEMBLIES

ASSEMBLY REFERENCE	FUNCTIONAL NAME	ASSEMBLY PART NO.
A1	Power Regulator Plug-In Assembly	057646
A1A1	Power Regulator PCB Assembly (+5,-5,+15)	05753501
A1A2	Power Regulator PCB Assembly (-5.2V,-15V,+24V)	05753502
A2	Rectifier PCB Assembly	05760601
A3	Motherboard PCB Assembly	05790001
A3A1	Frequency Switch PCB Assembly	05754101
A3A2	Display PCB Assembly	05754401
A3A3	Modulation Control PCB Assembly	05788201
A4	Synthesizer Assembly	05567201
A4A1	AC Discriminator PCB Assembly	05563901
A4A2	10 MHz VCO PCB Assembly	05566201
A4A3	DC Discriminator PCB Assembly	05537401
A4A4	Time Base PCB Assembly	05395401
A4A5	Source 2 PCB Assembly	05362401
A4A6	Source 3 PCB Assembly	05373501
A4A7	Extender PCB Assembly	
A4A8	400 MHz Reference PCB Assembly	05566801
A4A9	Control Logic PCB Assembly	05567101
A4A10	Divide-By-N PCB Assembly	05567001
A4A11	Source 4 PCB Assembly	05372401
A4A12	Phase Detector PCB Assembly	05538501
A4A13	Source 5 PCB Assembly	05797001
A4A14	Amplifier PCB Assembly	05392901
A4A15	Synthesizer	05569201

TABLE 4-1 MODEL R-1201A ASSEMBLIES (Cont'd)

ASSEMBLY REFERENCE	FUNCTIONAL NAME	ASSEMBLY PART NO.
A4A16	Mixer Assembly	05547001
A4A17	Connector PCB Assembly	05569301
A4A18	Local Oscillator PCB Assembly	05715301
A5	Oscillator Control PCB Assembly	05756001
A5	Oscillator Control PCB Assembly (TCXO Option)	05756002
A5	Oscillator Control PCB Assembly (High Stability Option)	05756003
U1	Attenuator Assembly	053994

The heart of the Signal Generator is the Synthesizer Assembly A4, which consists of an RFI enclosure containing 18 sub-assemblies, 13 of them being plug-in circuit boards. The Synthesizer A4 Assembly provides a number of functions that are not used with the Model R-1201A Signal Generator, i.e.; L.O. Output, IF Outputs, Level Detection (Squelch), AGC and other functions that relate to Receiver functions. Interface to the Synthesizer's internal circuits is provided via coax connector A4J22 1 MHz Time Base Input and A4J21 RF Output, and the Connector PCB Assembly A4A17. Table 4-2 provides the A4 Synthesizer interface information.

TABLE 4-2 SYNTHESIZER A4 INTERFACE

CONNECTOR & PIN NUMBER	SIGNAL NAME	TO/FROM
A4J21	RF OUTPUT	To Attenuator U1
A4J22	TB INPUT	From Clock Oscillator A5 pad (11)
A4XA17-3	FM CAL (Ground)	From A3 pad (14)
A4XA17-4	RCVR (+15V)	From A3 pad (13)
A4XA17-5	+24V	From A3 pad (41)
A4XA17-6	+5V	From A3 pad (47)
A4XA17-7	-5.2V	From A3 pad (49)
A4XA17-8	Ground	From A3 pad (14)
A4XA17-9	+15V	From A3 pad (13)
A4XA17-10	-15V	From A3 pad (45)
A4XA17-11	FREQ. SELECT OCTAL A	To A3 pad (6)
A4XA17-12	FREQ. SELECT OCTAL B	To A3 pad (7)
A4XA17-13	FREQ. SELECT BCD 1	From A3 pad (11)
A4XA17-14	FREQ. SELECT BCD 4	From A3 pad (10)
A4XA17-15	AM IN	From A3 pad (1)
A4XA17-C	FM ENABLE	From A3 pad (16)
A4XA17-D	FM IN	From A3 pad (17)
A4XA17-L	LEVEL	To A3 pad (4)
A4XA17-M	FREQ. SELECT OCTAL C	To A3 pad (8)

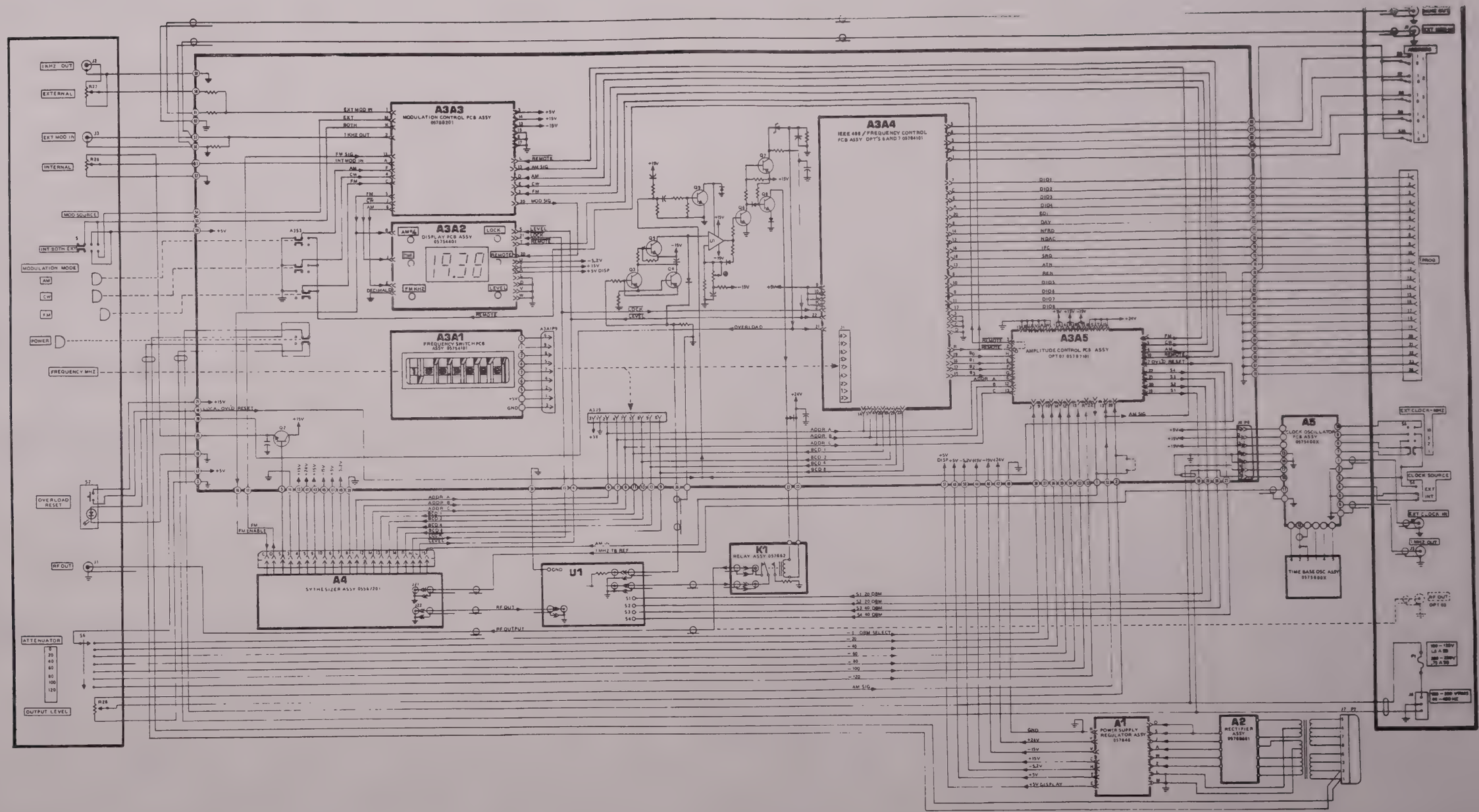


FIGURE 4-1
FUNCTIONAL BLOCK DIAGRAM

TABLE 4-2 SYNTHESIZER A4 INTERFACE (Cont'd)

CONNECTOR & PIN NUMBER	SIGNAL NAME	TO/FROM
A4XA17-N	LOCK	To A3 pad (15)
A4XA17-P	FREQ. SELECT BCD 2	From A3 pad (12)
A4XA17-R	FREQ. SELECT BCD 8	From A3 pad (9)
A4XA17-S	1 kHz OUT	To A3 pad (5)

The Mother PCB A3 contains five PCB Assemblies that provides the subfunctions of the the Signal Generators operation. The following Tables 4-3 through 4-5 provide the interface information of the A3A1 through A3A3 PCB Assemblies.

TABLE 4-3 FREQUENCY SWITCH PCB ASSEMBLY A3A1 INTERFACE

A3A1P9 PIN NUMBER	SIGNAL NAME	TO/FROM
1	GROUND	To A3J9-1
2	FREQ. SELECT OCTAL A	From A3J9-2
3	+5V	From A3J9-3
4	FREQ. SELECT OCTAL B	From A3J9-4
5	FREQ. SELECT BCD 1	To A3J9-5
6	FREQ. SELECT BCD 8	To A3J9-6
7	FREQ. SELECT OCTAL C	From A3J9-7
8	FREQ. SELECT BCD 2	To A3J9-8
9	FREQ. SELECT BCD 4	To A3J9-9

TABLE 4-4 DISPLAY PCB ASSEMBLY A3A2 INTERFACE

A3A2 EDGE CONNECTOR PIN NUMBER	SIGNAL NAME	TO/FROM
21,Y	$\overline{\text{LOCKED}}$	From A4A17-N
S	$\overline{\text{LEVELED}}$	From A4A17-L & A3R15
E	FM	From A3A3-5
J	CW	From A3A3-J
B	AM	From A3A3-6
T	$\overline{\text{REMOTE}}$	From A3A4-Z
20	MOD SIGNAL	From A3A3-20
10,D,L,V,W	Ground	From A3 pad (40)
Z	+15V	From A3 pad (44)
A	+5V	From A3 pad (48)
17	-5.2V	From A3 pad (50)

TABLE 4-5 MODULATION CONTROL PCB ASSEMBLY A3A3 INTERFACE

A3A3 EDGE CONNECTOR PIN NUMBER	SIGNAL NAME	TO/FROM
20	MOD SIGNAL	To A3A2-20
5	FM	To A3A2-E
J	$\overline{CW}$	To A3A2-J
6	AM	To A3A2-B
13	AM OUT	To OUTPUT LEVEL CONTROL R28 and A3A5-13
M	EXT	From MOD SOURCE SWITCH S1 via A3 pad (54)
K	BOTH	From MOD SOURCE SWITCH S1 via A3 pad (55)
12	FM OUT	To A4XA17-D via A3 pad (17)
C	LOCAL FM	From MOD MODE SW A3S3
4	LOCAL CW	From MOD MODE SW A3S3
F	LOCAL AM	From MOD MODE SW A3S3
2	1 kHz OUT	To 1 kHz OUT connector J2 via A3 pad (57)
1	EXT MOD IN	From swinger of R27 via A3 pad (59)
A	INT MOD IN	From swinger of R26 via A3 pad (61)
14	+15V	From A3 pad (44)
H	+5V	From A3 pad (48)
17,18	Ground	From A3 pad (40)
16,T	-15V	From A3 pad (46)

The Frequency Switch PCB Assembly A3A1 interfaces with the Synthesizer A4 via connector A3J9.

The frequency selection is by a 1-2-4-8 binary coded decimal (BCD) and an A-B-C Octal number format. The frequency selection is encoded to the proper format by the logic located within the Frequency Switch Assembly A3A1.

The r-f output of the Synthesizer at connector A4J21 is a fundamental frequency (non-harmonic) of 100 Hz discrete steps as selected by the Frequency Switch. The accuracy (stability) of the r-f output is referenced to the Clock Oscillator 1 MHz Time Base input at A4J22. The Synthesizer is normally referenced to the standard 1 MHz reference oscillator having a $\pm 2 \times 10^{-8}$ parts per week, or the optional reference oscillator having a $\pm 3 \times 10^{-9}$ parts per day stability. A Rear Panel BNC connector J6 (EXT CLK IN) allows for the application of a 1 MHz, 2 MHz, 5 MHz or 10 MHz reference from an external frequency standard, when the Rear Panel CLK SOURCE switch S4 is placed in its EXT Position and the EXT CLOCK MHz S5 selector switch is set to its appropriate position. The Rear Panel 1 MHz OUT J5 BNC connector allows for monitoring the 1 MHz clock which is the compliment of the +5V TTL reference clock applied to A4J22.

The Synthesizer supplies an r-f output at A4J21 that is adjustable from 0.1 Vrms to 1 Vrms by the Output Level control R28. The A4J21 r-f output is applied via coax cable to the Attenuator Assembly U. The Attenuator Assembly is a seven step (-20

dB per step) attenuator which provides 0 dB to 120 dB attenuation of the r-f output. The attenuator is stepped by switch S6.

The Attenuator output is applied to Relay Assembly K1. The relay provides overload protection of the output circuit of the Signal Generator. Circuitry located on the Mother PCB A3 provides the output overload detection and the relay trip function. The output r-f level is sensed by the signal developed across resistor A3R2. This signal is then detected by diode A3CR1 and capacitors A3C2 and A3C3 to a dc level which is then sampled by the circuit comprised of transistors A3Q3, A3O4 and A3Q5 to generate an overload sense signal. The overload sense signal is applied to differential amplifier A3U1 pin 2. Potentiometer A3R8 adjusts the overload trip point of the output protector circuit by setting the negative reference level on A3U1 pin 3. A3U1 functions as a sample and hold fase response voltage follower. The circuit is reset by the OVERLOAD RESET signal generated by the Front Panel OVERLOAD RESET switch S2. This OVERLOAD RESET is a +15V transition which will unlatch A3U1 via transistor A3Q9. When an overload trip is generated at A3U1 pin 6, the output protector relay K1 will de-energize and open up the r-f output to the RF OUT connector, terminating the r-f output to ground via its internal 56Ω resistor. Transistor A3Q7 will generate a $\overline{\text{LEVEL}}$ and an OVERLOAD signal as a +15V or its collector on an overload trip condition. The $\overline{\text{LEVEL}}$ signal is applied to the Display Assembly A3A2 pin S to extinguish its LEVEL LED indicator A3A2DS10. The OVERLOAD signal is applied to the Front Panel OVERLOAD RESET switch S2 to illuminate its LED.

The Front Panel MOD SOURCE switch S1 interfaces with the Modulation Control Assembly A3A3 pins L and K to provide selection of the modulation source. When the MOD SOURCE switch is placed in INT A3A3 pin K and L are both pulled low via internal resistors and effects the selection of the INT MOD IN signal at A3A3 pin A as the modulation source. This INT MOD IN signal is obtained from the Synthesizer at A4A17 pin S as a 1 kHz signal (INT MOD SOURCE) and applied via transistor A3Q2 and the INT MOD Front Panel control R26 to A3A3 pin A. When the MOD SOURCE switch is placed in EXT A3A3 pin M is set to a logic high and effects the selection of the EXT MOD IN signal at A3A3 pin 1. This EXT MOD IN signal is obtained from the EXT MOD IN Front Panel connector and applied via EXT MOD Front Panel control R27, to A3A3 pin 1. When the MOD SOURCE switch is placed in BOTH, A3A3 pin K is set to a logic high and effects the selection of both the EXT MOD IN signal at A3A3 pin 1 and the INT MOD IN signal at A3A3 pin A.

The MODULATION MODE switch A3S3 which is mounted on the Mother PCB A3 and operated via the Front Panel interfaces with the Modulation Control Assembly A3A3 pins C, 4 and F to provide selection of the type of modulation. A $\overline{\text{REMOTE}}$ signal as a logic high, is applied to the MODULATION MODE switch A3S3 to enable its function. When FM mode is switch selected a logic high is set on A3A3 pin C which will enable the FM OUT signal at A3A3 pin 12 which is applied to the Synthesizer at A4A17 pin D, a FM flag is also generated as a logic high at A3A3 pin 5 which is applied to the Display Assembly A3A2 pin E to illuminate its FM-kHz LED annunciator A3A2DS5. The FM flag is also applied to the Synthesizer at A4A17 pin 16 as an FM ENABLE. Whe CW mode is switch selected a logic high is set on A3A3 pin 4 which will enable an unmodulated dc level at A3A3 pin 13 as the AM OUT signal, a $\overline{\text{CW}}$ flag is also generated at A3A3 pin J as a logic low which is applied to the Display Assembly A3A2 pin J to illuminate its CW LED annunciator A3A2DS7 and inhibit the 3-1/2 digit display. When the AM mode is switch selected a logic high is set on A3A3 pin F which will enable the AM signal at A3A3 pin 13, an AM flag is also generated at A3A3 pin 6 as a logic high which is applied to the Display Assembly A3A2 pin B to illuminate its AM-LED annunciator A3A2DS6.

A shaped and level adjust 1 kHz signal at A3A3 pin 2 which is always presetn regardless of modulation selection is applied to the Front Panel 1 kHz OUT connector J2. The Modulation Control Assembly A3A3 outputs an analog voltage level that relates to the percentage (%) of AM or deviation in kHz of FM at A3A3 pin 20 as the MOD SIG. The MOD SIG is applied to the Display Assembly A3A2 pin 20 to provide a 3-1/2 digit numerical display of the modulation is either % of AM or deviation in kHz of FM.

The Signal Generators Power Supply consists of a mian chassis mounter power transformer T1, the Rectifier PCB Assembly A2, the plug-in Power Supply Regulator Assembly A1 and the ac line selector plug/connector P7/J7.

The ac line voltage is supplied to the Signal Generator via the Rear Panel 100-250 VRMS 48-420 Hz connector J4. The Signal Generator is protected from ac line over loads by the Rear Panel mounted fuse F1 (1.5A SB for 100 to 125V operation and 0.75A SB for 200 to 250V operation). The ac line voltage is connected directly to connector A3J8 pins 10 and 12 to supply ac to the oven of the optional high stability oscillator when installed, thus allowing the Oscillator oven to remain on whenever the Signal Generator is connector to an ac line source. When the optional high stability Oscillator is installed a PC mounted 115-230V switch S6 is provided to allow for the proper ac line voltage setting. The ac line voltage is also routed via the Front Panel POWER on-off pushbutton switch S3 to the ac line selector connector J7 pin 1 and 2. Six different ac line select plugs, plug into connector J7 to provide for the different line voltage configuration of the power transformer T1 primary connections. Table 4-6 provides the P7 jumper connection configuration, part number and wire color code as related to line voltage requirement.

TABLE 4-6 P7 PLUG CONFIGURATIONS

LINE VOLTAGE	JUMPER CONNECTIONS PINS	PINS	PART NUMBER	COLOR CODE
110	2-8	1-3-7	05767801	Brown
115	2-8	1-4-6	05767802	White
125	2-8	1-5-9	05767803	Red
200	1-7	3-8	05767804	Orange
215	1-7	6-8	05767809	Gray
230	1-4	6-8	05767805	Yellow
240	1-5	6-8	05767807	Violet
250	1-5	8-9	05767806	Green

The secondary windings of the power transformer T1 interface with the Rectifier PCB Assembly A2. The Rectifier PCB Assembly contains ten type 1N4005 diodes that are configured as two bridge rectifiers and one full wave rectifier. The bridge rectifier consisting of A2CR1 through A2CR4 supply raw dc voltages to the voltage regulators located on Assembly A1A1, and the bridge rectifier consisting of A2CR5, CR6, CR8 and CR9 supply raw dc voltages to the voltage regulators located on Assembly A1A2. The full wave rectifier comprised of A2CR7 and A2CR10 supply raw dc voltage to the +24V regulator located on Assembly A1A2. Five main chassis mounted filter capacitors C1 through C5 are connected between the five raw dc outputs from the Rectifier Assembly A2 and the power supply returns.

Power Regulator A1 consists of two subassemblies A1A1 and A1A2 which contains the regulators for the six regulated dc outputs. Table 4-7 provides a listing of the power supply regulator components that relate to the six power supply outputs.

TABLE 4-7 REGULATOR POWER SUPPLY COMPONENTS

XA1 CONNECTOR PIN NUMBER	OUTPUT VOLTAGE	REGULATOR(s) REF DESIGNATOR & TYPE	FILTER CAP REF DESIGNATOR
T	+5V (DISPLAY)	U3 MC7805 Q1 2N6040 Q2 2N4918	C6 and C7
E	+5V (V_{cc})	U2 MC7805	C10 and C11
C	+15V	U1 MC7815	C8 and C9
Y	+24V	U4 MC7824	C14 and C15
V	-15V	U5 MC7915	C16 and C17
H	-5.2 (V_{ee})	U6 MC7905.2 Q3 2N6043 Q4 2N4921	C12 and C13

4.3 SYNTHESIZER ASSEMBLY FUNCTIONAL DESCRIPTION

The Synthesizer generates a fundamental (non-harmonic) r-f output having a frequency of 100 Hz to 999.9999 MHz that is selected in 100 Hz steps by the Frequency switch setting. Figure 4-2 provides a functional block diagram of the Synthesizers signal generation process. The following description is referenced to Figure 4-2, and the Synthesizer Mother PCB Schematic Diagram located in Chapter 7 of this manual.

The Synthesizer Assembly used in the Signal Generator provides a number of functions that are not used, i.e.; L.O. output, IF outputs, Level Detection (Squelch), AGC and other functions that relate to receiver functions. The following descriptions, paragraphs 4.2 and 4.3, relate to the Synthesizer Assembly in its complete functional configuration.

The Synthesizer contains twelve voltage controlled oscillators (VCO), five phase detectors and three hetrodyne mixer circuits that comprise of 2 major and four secondary phase-lock loops. All the reference signals i.e.; 400 MHz, 10 MHz, 0.5 MHz and 1 kHz relate and are referenced to the 1 MHz Time Base Oscillator.

Digital phase/frequency lock loop techniques are used, which compares the frequency and the phase of the input (reference) signal to the output of the VCO which is fedback via a divider counter or a mixer to the phase detector. The phase detector receives the reference, along with the VCO feedback from a divider counter or mixer and compares these for any phase/frequency difference. A resultant differance signal (a dc level) produced by the phase detector adjusts the frequency of the VCO. If the signals are in phase, a lock is achieved, after which, the VCO will continue to track the reference.

The Frequency Switch Assembly A3A1, interfaces with the Time Base Assembly A4A4 allowing the frequency selection input. The Time Base outputs the 10^2 through 10^5 digit strobes and the 1-2-4-8 BCD Frequency code to the Source 2 Assembly A4A5 to program the A4A5 ÷N Counter.

The Source 2 VCO generates 10.000-19.999 MHz frequency that is phase-locked to the 1 kHz REF signal, the actual frequency that the VCO locks on is determined by the ÷N counter N number which is programmed by the Frequency Switch setting. A ÷10 counter divides the VCO frequency to produce a 1.0000-1.9999 MHz output which is applied to the Source 3 Assembly A4A6.

Source 3 Assembly A4A6 contains a 11.0000-11.9999 MHz VCO. When operating in the CW mode its output is heterodyned with the 10 MHz REF signal from the 400 MHz Reference Assembly A4A8 by the mixer which produces an IF output of 1.000-1.999 which is applied to the phase detector via the low pass filter, thus, developing a phase-lock loop. When the FM mode is selected the 10 MHz REF is removed from the mixer and the FM IN signal is applied. This FM IN signal has a center frequency of 10 MHz and a deviation of up to 20 kHz, which will modulate the Source 3 output frequency.

The Phase Detector Assembly A4A12 compares the phase difference of the Source 3 A4A6 and the Mixer Assembly A4A16 outputs, and generates the High Band and Low Band Frequency Control signals. The High Band and Low Band Frequency Control signals are applied to the Source 5 Assembly to enable its selected VCO to search and lock on to the selected frequency.

The Frequency Tracking signal for the Source 5 VCO's and the Frequency Control signal for the Source 4 VCO's are generated by the Divide-By-N Assembly A4A10. The ÷N decade counter circuit is programmed to divide the count by an N number that relates to the 10^6 - 10^8 BCD frequency code. This code in turn relates to the Frequency selection, and is generated by the Logic Assembly A4A9 via the Time Base 10^6 - 10^8 Hz strobes and the 1-2-4-8 BCD frequency code. The 89-498 MHz Source 4 output is divided by 10 or by a two modulus 10/11 prescaler and then divided by the programmed N number by the N counter circuit. The ÷N counters output is compared by the phase detector with the 1 MHz or 0.5 MHz reference signals, (the 0.5 MHz REF is selected when the Logic Assembly A4A9 generates the X2 command). The phase detector circuit outputs the Frequency Tracking and Frequency Control signal via its integrating amplifier to the Source 5 and Source 4 Assemblies, respectively.

Source 4 Assembly A4A11 contains four VCO's that are controlled by the Frequency Control signal generated by the Divide-By-N Assembly A4A10. The VCO output gate enabled from the Logic Assembly will select one of the four VCO's. The output at J2 is a signal of 89-498 MHz in 1 MHz steps or 0.5 MHz steps when doubling, and is applied to the Divide-By-10 Assembly to complete the Source 4 phase-lock frequency control loop. The other Source 4 output at J1 is a signal of 89-498 MHz in 1 MHz steps, the actual frequency is dependent on which VCO is selected and if the X2 mixer is enabled by the X2 command applied to A4A11 pin M. This 89-998 MHz signal is applied to the Mixer Assembly A4A16 where it is heterodyned with the 110.0000 - 999.9999 MHz Source 5 signal to generate the 11.0000-11.9999 MHz IF that is applied to the Phase Detector Assembly at A4A12 pin Y.

The Source 5 Assembly contains five VCO's that are selected (one of the five) by the gate enable signals from the Logic Assembly. The four lower frequency VCO's (110.0000-599.9999 MHz) are tuned by the Low Band Frequency Control signal from the PHase Detectors Search Generator which is applied to A4A13 pin X. The High Band VCO (600.0000-999.9999 MHz) is tuned by the High Band Frequency Control which is also generated by the Phase Detector Assembly and applied to A4A13 pin H. The tracking signal from the Divide-By-N Assembly A4A10, is applied to the Source 5 (110.0000 - 199.9999 MHz) VCO via A4A13 pin F to prevent locking on to a VCO harmonic. The selected VCO output is gate enabled and applied to the A4A13J2 output coax connector via the appropriate Low Pass Filter. This 110.0000-999.9999 MHz output at A3A13J3 is then applied to the Mixer Assembly A4A16J2. The output to the Amplifier Assembly is provided via pin Diode Attenuator circuit that is back biased by the Source 5 leveling signal applied to A4A13 pin Y. Then the leveled 110.0000-999.9999 MHz output is routed from A4A13J1 to the Amplifier Assembly input coax connector A4A14J1.

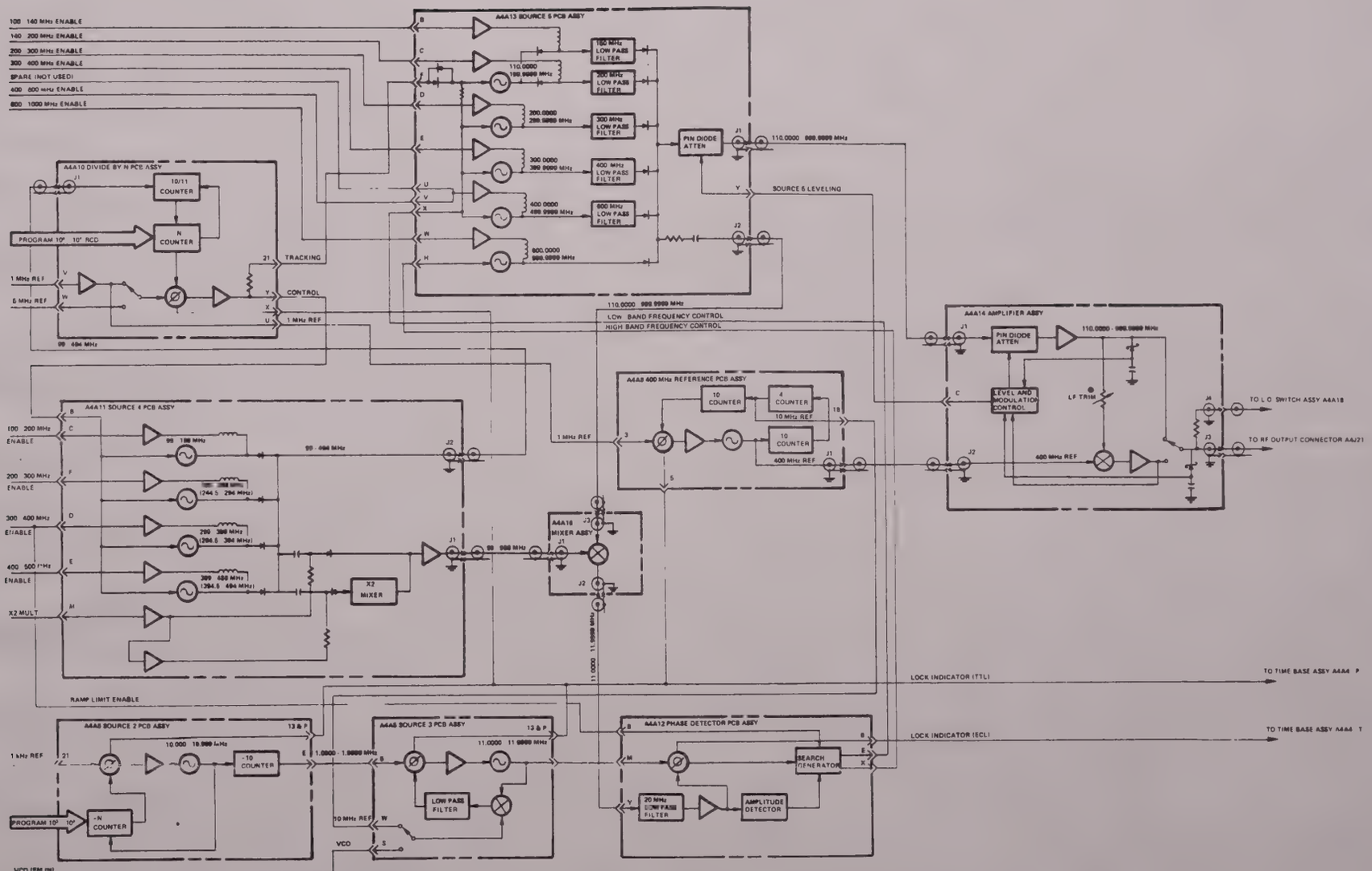


FIGURE 4-2
FUNCTIONAL BLOCK DIAGRAM
SIGNAL GENERATION PROCESS

The Amplifier Assembly A4A14 contains the Level and Modulation Control circuits, an input Pin Diode Attenuator circuit, the Mixer circuit to generate the 100 kHz - 109.9999 MHz output, and the coax relay which selects either the 110.0000-1009.9999 MHz of the Mixers 100 kHz - 109.9999 MHz output. The Source 5, 110.0000-1009.9999 MHz output is applied to the PIN Diode Attenuator via connector A4A14J1. The leveled output is then amplified and routed to the L.O. Switch Assembly A4A18 via coax connector J4 and to the RF Output connector A4J21 via coax connector J3. When the Synthesizer output is from 100 Hz to 109.9999 MHz the coax relay is pulled and the output source is from the Mixer circuit via its associated amplifier. This mixer hetrodynes the Source 5 output with the 400 MHz Reference signal from the 400 MHz Reference Assembly A4A8, to generate the 100 kHz-109.9999 MHz output.

4.4 SYNTHESIZER DETAILED CIRCUIT DESCRIPTIONS

The following subparagraphs provide the detailed theory of operation and circuit analysis at the circuit level. These circuit descriptions are referenced to the schematic diagrams of the individual operational assemblies and plug-in PC boards located in Chapter 7 of this manual.

4.4.1 AC Discriminator PCB Assembly A4A1

The AC Discriminator Assembly receives the 10 MHz IF input from the 10 MHz VCO Assembly A4A2 which is applied to A4A1 pin W then ac coupled via C27 to pin 1 of U3. Integrated Circuit U3 is an RCA CA3089E FM IF and Discriminator System that contains a three-stage IF amplifier/limiter input, a doubly-balanced quadature detector, an audio output amplifier and a delayed AGC output. The Discriminator output at U3 pin 6 is applied to differential amplifier U5 at input pin 3 via the bilaterial switch U1A. The other input to U5 at pin 2 is the FM Detectors reference bias from U3 pin 10 via the GAIN adjustment potentiometer R1. Amplifier U5 outputs the recovered audio at pin 6 to the PCB's pin M to route it to the DC Discriminator Assembly A4A3. U5's output at pin 6 is also applied to the Differential Integrator Amplifier U4 at pin 2 and compared with the reference bias level from the FM detector (U3-10) which is applied to U4 pin 3. The Integrators time constant is determined by capacitor C24 (1 mfd) and resistor R14 (10 MΩ). The Integrators output at U4 pin 6 is applied to varicap CR1 to tune the FM detectors L-C tank circuit comprised of CR1,C15,C17 and L3.

The FM detectors AGC output at U3 pin 15 is applied via transistor driver Q2 to the Level Detector U2 input at pin 3 and to the PCB's output pin H as the AGC OUT signal. The Level Detector U2 will output the MUTE signal when the AGC signal level is greater than the level applied to U2 pin 2 by the Level Set potentiometer R18. Emitter follower Q4 and Q5 provides the drive to output the LEVEL DETECT (SQUELCH) signal. The MUTE signal is also applied to the bilateral switches U1A and U1C as a control enable, which will select either the FM Detector (signal present) or the Integrator (squelched) output as the input to U5 pin 3. The Integrators output is fed back to its input via U5 to maintain the AFC voltage across CR1, when no signal is present.

4.4.2 10 MHz VCO PCB Assembly A4A2

The VCO circuit is comprised of FET Q3 and its associated components, with varicap CR4 being its voltage/frequency tuning control device. The VCO circuit is enabled when the FM ENABLE signal is high at PCB input pin C which will apply a +15V to the VCO FET Q3 and the VCO IC Amplifier (U3) via the enable circuit comprised of transistors Q1 and Q2. Integrated circuit U2 is a summing amplifier for the 2 frequency control signals; ERROR IN, MOD IN and FM CAL IN. The VCO control signal present at the output of the summing amplifier U2 pin 6 is applied to the varicap CR4 to modulate or offset the VCO OUT 10 MHz signal at PCB pin Y output. Integrated circuit U3

is a high-gain (80 dB) wideband (>20 MHz) amplifier/limiter, its output (U3 pin 4) is coupled via emitter follower Q9 to the VCO output at PCB pin Y which is applied to the Source 3 Assembly A4A6 pin S via a coax cable. The VCO output is also coupled to the IC Amplifier U4 via capacitors C22 and C33.

IF Amplifier U4 output at pin 4 is coupled via capacitor C37 to a buffer emitter follower circuit comprised of transistors Q5,Q7 and Q10 which provides the drive and fanout of the four IC fisnals to PCB output pins W,R,T and S. The VCO's output is also applied to emitter follower circuit comprised of transistors Q4 and Q6 which provide the drive for the 10 MHz IF to the Ac Discriminator Assembly A4A1 via PCB pin 19. The IF IN signal applied to PCB pin U is enabled by the gate consisting of CR12,13 and 14 when the RCVR ENABLE applied to PCB pin P is set at a logic low. The gate output is coupled by capacitor C22 and to the IF Amplifier U4 and the emitter follower circuit Q4 and Q6 to provide the receiver IF as the output when the receiver mode is selected.

4.4.3 Source 2 PCB Assembly A4A5

The Source 2 Assembly generates a 1.000-1.999 MHz output having 10 Hz discrete steps. Figure 4-3 provides a block diagram of the Source 2 functional operation.

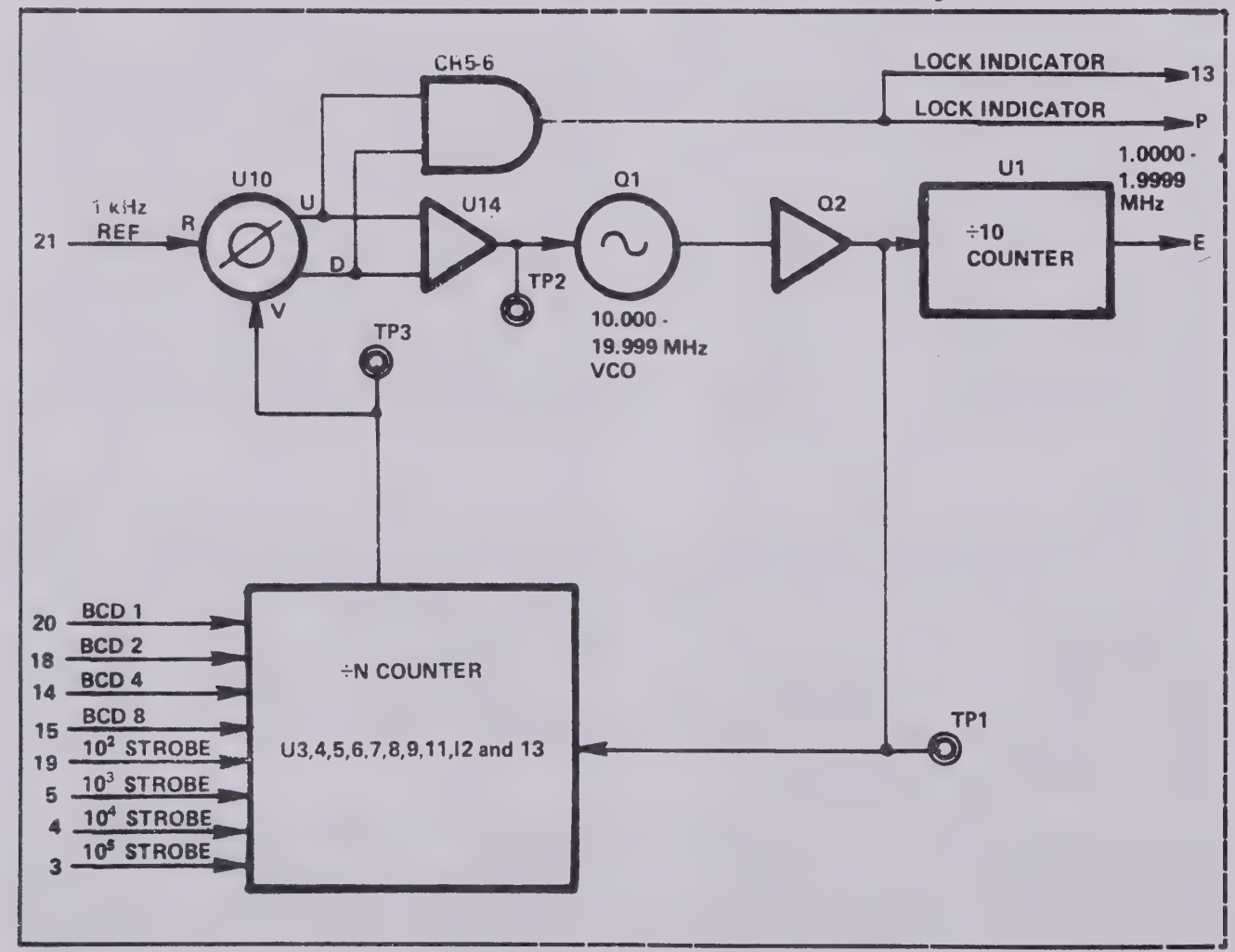


FIGURE 4-3 SOURCE 2 FUNCTIONAL BLOCK DIAGRAM

The VCO circuit consists of FET Q1 and its associated circuit components. Varicap CR1 is the voltage/frequency controlling device, which is tuned by the voltage level that is generated by the phase detector integration amplifier U14. The VCO generates a 10.000 to 19.9999 MHz signal having 1 kHz discrete steps which is fed to the ÷10 counter circuit (U1 pin 6). The ÷10 counter divides the VCO output frequency by 10 and outputs a 1.0000 to 1.9999 MHz signal in 100 Hz steps at U1 pin 5 as the SOURCE 2 OUTPUT signal which is applied to the PCB output connector pin E.

The VCO output is also applied to the ÷N counter circuits control logic IC (U3 pin 1) and the 10^2 decade programmable counter (U4 pin 6). The ÷N counter circuits divides this VCO output by an integer (N) that is programmed by the 1-2-4-8 BCD and the 10^2 through 10^5 decade strobes, (these program control data signals are generated by the Time Base Divider A4A4 and relates to the frequency switch setting).

The ÷N counter outputs to the phase detector V input (U10 pin 3), where it is referenced to the 1 kHz reference signal applied to the R input (U10 pin 1). The phase detector responds only to negative transitions, hence the phase error is independent of duty cycle or amplitude variations. The phase detector outputs, up (U) and down (D) at U10 pins 13 and 2, respectively, are applied to amplifier U14, and the resulting average level at U14 pin 6 is the phase difference error signal which is applied to the VCO to increase or decrease its frequency. The phase detectors U and D outputs will remain high when the reference input (R) and the variable input (V) negative transitions coincide, thus indicating a phase lock. The phase detectors outputs will have short duration, low amplitude, negative pulse present on its output levels. When phase lock is achieved the "AND" gate comprised of diodes CR5 and CR6 outputs a TTL logic high at PCB pins 13 and P which is the LOCK INDICATOR signal which is routed to the Time Base PCB Assembly.

4.4.4 Source 3 PCB Assembly A4A6

The Source 3 Assembly is a VCO which utilizes a mixer in its phase-lock loop to generate an output of 11.0000-11.9999 MHz. Its input is the 1.0000-1.9999 MHz Source 2 signal which is heterodyned with the 10 MHz REF signal when the CW mode is selected, or the 10 MHz VCO (FM IN) signal when the FM mode signal is selected. The mixers output is the phase-lock reference for the applied Source 2 input. Figure 4-4 provides a block diagram of the Source 3 functional operation.

The 1.0000-1.9999 MHz Source 2 signal is applied to the phase detector at its V input (U3 pin 9) via PCB connector pin 5. The reference input to the phase detector (U3 pin 6) is the mixers output (U2 pin 10) which is applied via the external PCB connection between PCB connector pins B and C. The phase detector outputs, Up and Down signals at U2 pins 12 and 3, respectively, are applied to the integrating amplifier U4 and the resulting average level at U4 pin 6 is the phase difference error signal which is applied to the VCO via the external PCB connection between PCB connector pin R and V. The phase detectors pins 12 and 3 outputs will remain high when the reference and the variable input negative transitions coincide, thus indicating a phase lock. When phase lock is achieved the AND gate (CR7 and CR6) outputs a TTL logic high via driver U5 to PCB pins P and 13 which is the LOCK INDICATOR signal and is routed to the Time Base PCB Assembly.

The VCO 11.0000-11.9999 MHz output is applied via transistor driver Q5 to the mixer input U2 pin 8 and to the PCB connector pin Y, which is the Source 3 output.

The Mixer U2 heterodynes the VCO output applied to U2 pin 8 with the 10 MHz REF or the VCO (FM IN) signal applied to U2 pin 4. The mixers output at U2 pin 10 is routed via the low pass filter (L6,L7,C18,C19 and C20), to the transistor driver (Q2 and Q3) and the external connection between PCB connector pins B and C to the phase detector input at U3 pin 6.

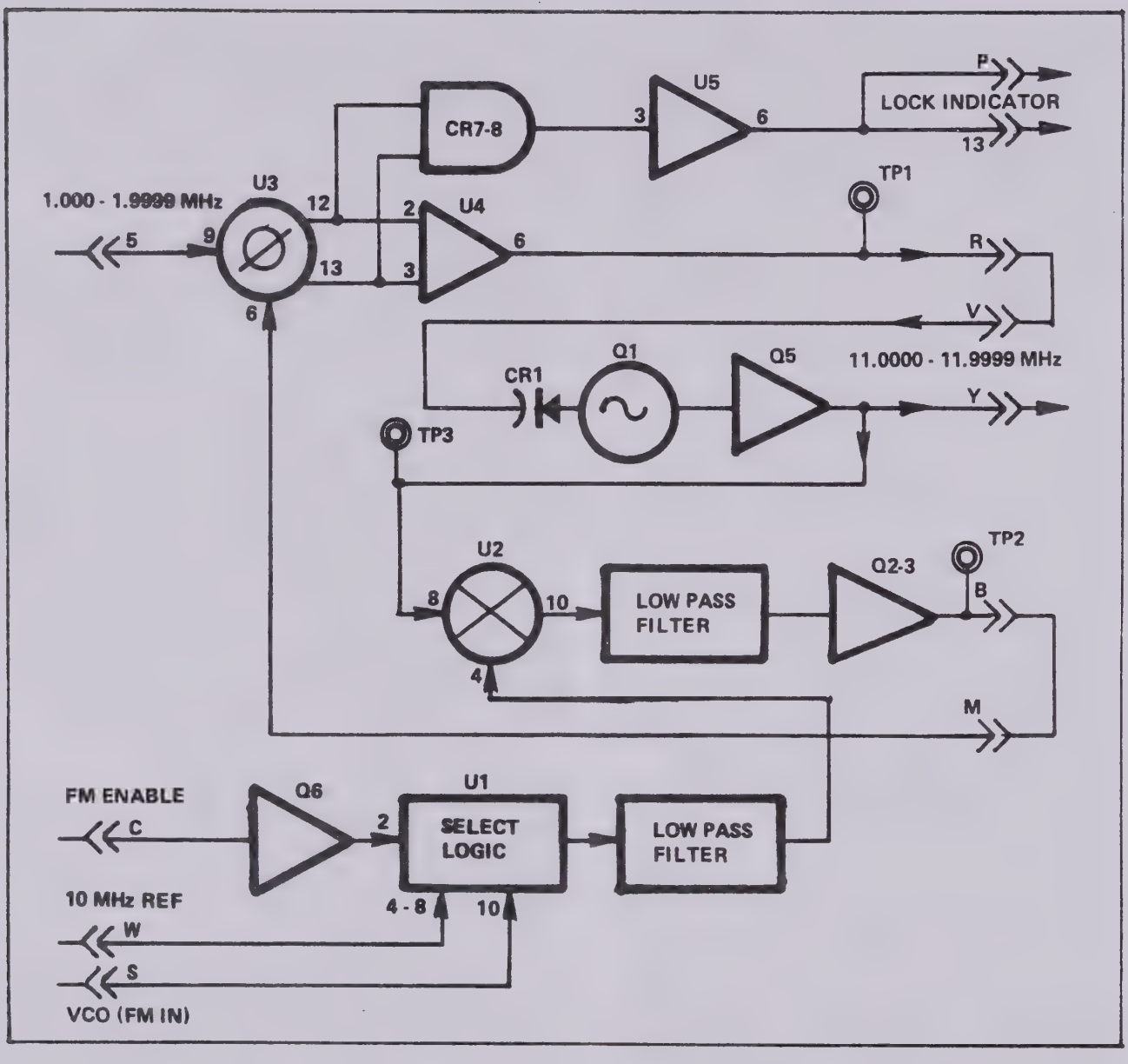


FIGURE 4-4 SOURCE 3 FUNCTIONAL BLOCK DIAGRAM

Integrated Circuit U1 provides the selection logic, to select either the 10 MHz REF input at PCB connector pin W, or the VCO (FM IN) signal at PCB connector pin S.

When the RCVR, CW or AM mode is selected by the Front Panel pushbutton switches the FM ENABLE at PCB connector pin U is set to a logic low, thus enabling the 10 MHz REF as the input to the mixer via the low pass filter comprised of L4,L5,C13,C14 and C15. When the FM mode is selected by the FM pushbutton switch, the FM ENABLE at PCB connector pin U is set to a logic high and the VCO (FM IN) signal is enabled.

4.4.5 Source 4 PCB Assembly A4A11

Source 4 generates a 99-998 MHz signal which is applied to the Mixer PCB Assembly A4A16 via the output coax connector J1, and a 99-498 MHz signal at coax connector J2 which is applied to the Divide-By-N PCB Assembly A4A10. The Source 4 frequency

generation is by one of the four FET VCO's which is selected by the proper enable signal from the Logic PCB Assembly A4A9. The selected VCO is tuned by the FREQUENCY CONTROL signal from the Divide-By-N PCB Assembly A4A10. Figure 4-5 provides a block diagram of the Source 4 functional operation.

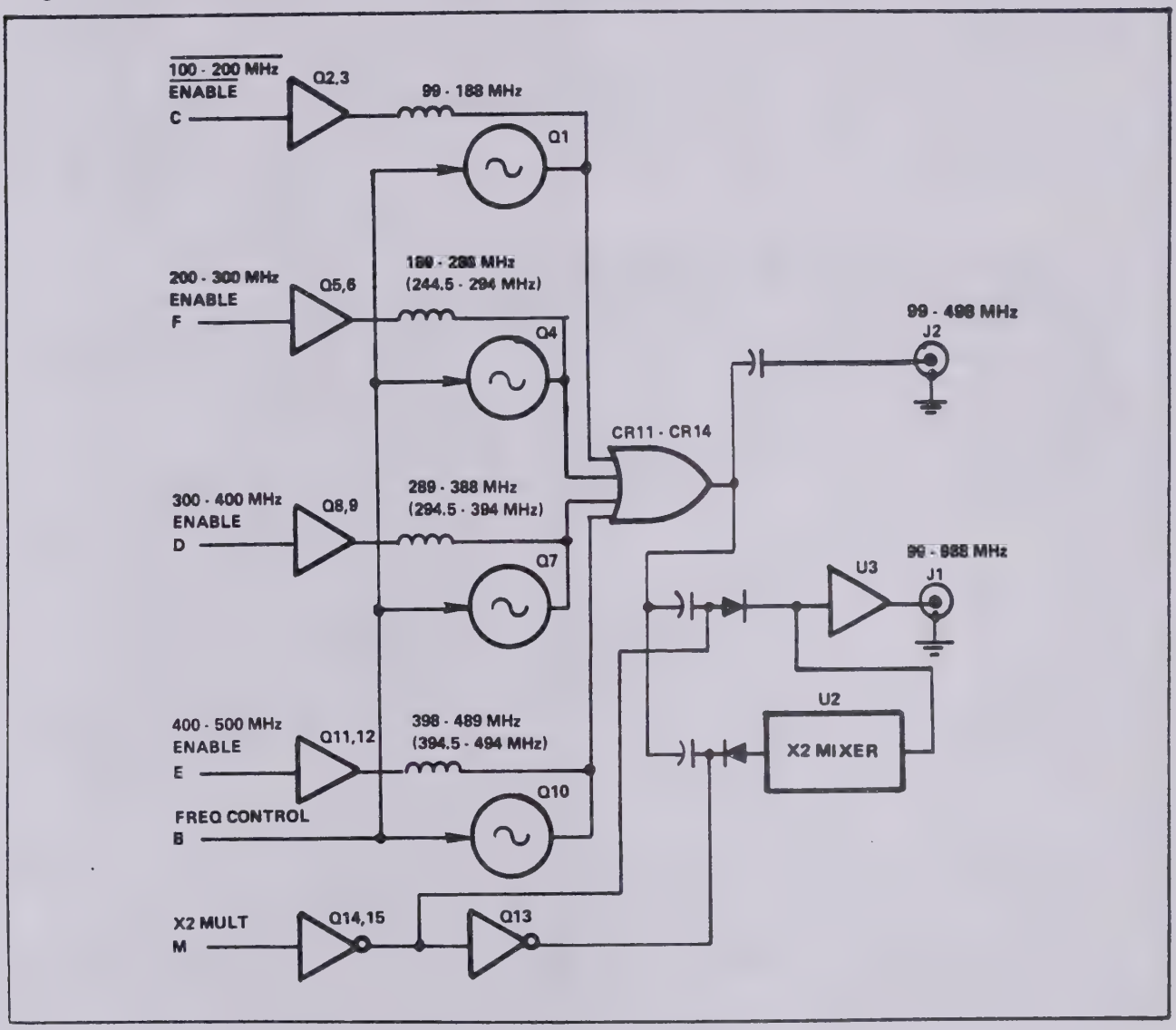


FIGURE 4-5 SOURCE 4 FUNCITONAL BLOCK DIAGRAM

The four VCO's are configured by FET's Q1,Q4,Q7 and Q10 and their associate circuit components, and are tuned by the FREQUENCY CONTROL signal applied to PCB connector pin B from the Divide-By-N PCB Assembly A4A10. The proper VCO is enabled when an ENABLE signal is applied to its associated transistor switch circuit, which in turn applies +15V to the FET's drain. The enabled VCO output is applied to the PIN diode "OR" gate comprised of diodes CR11 thorugh CR14.

The PIN diode "OR" gate supplies two signals. One being the 99-498 MHz signal at coax connector J2 to the Divide-By-N Assembly A4A10. The other PIN diode "OR" gate output is applied via capacitors C12 and C13 to the PIN diode X2 multiplier switch circuit. When the X2 signal from the Logic Assembly A4A9 is set to a logic low at

PCB connector pin M, the X2 switch circuit consisting of Q13,Q14 and Q15 will enable PIN diode switch CR16 and disable PIN diode switch CR15, allowing the VCO output to be applied to the output driver U3 via the X2 mixer circuit U2, thus doubling the VCO output frequency. When the X2 signal at PCB connector pin M is placed at a logic high PIN diode CR15 is enabled and PIN diode CR16 is disabled, thus inhibiting the frequency doubler function. Amplifier driver U3 outputs the 99-998 MHz Source 4 signal to the Mixer Assembly A4A16 via coax connector J1.

4.4.6 Source 5 PCB Assembly A4A13

The Source 5 Assembly generates a 110.0000-1009.9999 MHz signal which is supplied to the Amplifier Assembly A4A14 via coax connector J1 and to the Mixer Assembly via coax connector J2. Figure 4-6 provides a block diagram of the Source 5 functional operation.

The Source 5 output signals are generated by one of the 5 VCO's comprised of Q1 through Q3 and Integrated Circuit U1 and their associated components. The proper VCO is selected by its enable signal from the Logic Assembly A4A9. When the 110-140 MHz ENABLE is placed at a logic high at PCB connector pin B, the enable switch circuit Q6 and Q13 will place +15V on diode CR4, which will enable the VCO Q1 and apply a 110.0000-139-9999 MHz signal via the 150 MHz low pass filter to the "OR" gate CR23 input diode. When the 140-200 MHz ENABLE is set high at PCB connector pin C, the enable switch circuit Q7 and Q14 will apply +15V to diode CR5, which will enable the VCO Q1 and apply a 140.000-199-9999 MHz signal via the 200 MHz low pass filter to the "OR" gate CR22 input diode. When the 200-300 MHz ENABLE is set low at PCB connector pin D, the enable switch circuit Q8 and Q15 will apply a +15V to VCO Q2 allowing the generation of a 200.000-299.9999 MHz signal, which is applied to the "OR" gate diode CR21 input. The 300.0000-399.9999 MHz VCO Q3 is enabled by a logic low applied to the PCB connector pin E via the enable switch circuit comprised of Q9 and Q16, and allows a VCO output to CR18 of the "OR" gate via the 400 MHz low pass filter. When the 400-600 MHz ENABLE is placed at a logic low on PCB connector pin V the VCO U1A will be enabled via switch circuit Q10 and Q17 and output a 400.0000-599.9999 MHz signal to the "OR" gate input CR19 via the 600 MHz low pass filter R60 and C35. The 600.0000-1009.9999 MHz VCO U1B is enabled by a logic high at PCB connector pin W via the switch circuit Q11 and Q18, allowing its signal to be outputted via "OR" gate CR20.

The LOW BAND CONTROL is generated by the Phase Detector A4A12 Assembly and applied to PCB connector pin F. This signal will tune the selected low band VCO Q1 through U1A to the selected frequency. The TRACKING signal applied to pin H by the Divide-By-N Assembly prevents the Q1 oscillator from locking on to the Source 4's second harmonic when the selected frequency is at the low end of the oscillators range.

The HIGH BAND CONTROL generated by the Phase Detector A4A12 Assembly is applied to PCB connector pin X to tune the high band VCO U1B.

The "OR" gate outputs the 110.0000-1009.9999 MHz signal to coax connector J2 via capacitor C32. The other output of the "OR" gate coupled by capacitor C28 is applied to the PIN diode variable attenuator circuit which controls the output at coax connector J1. The attenuation is controlled by the LEVEL SIGNAL applied to PCB connector pin Y. This leveled 110.0000-1009.9999 MHz signal output at J1 is applied to the Amplifier Assembly A4A14.

4.4.7 Control Logic PCB Assembly A4A9

The Control Logic Assembly A4A9 receives the frequency 1-2-4-8 BCD code and the 10^6, 10^7 and 10^8 Strobes from the Time Base Assembly A4A4 which relates to the Front Panel Frequency switch settings. Also applied to the Assembly at pin C is the RCVR

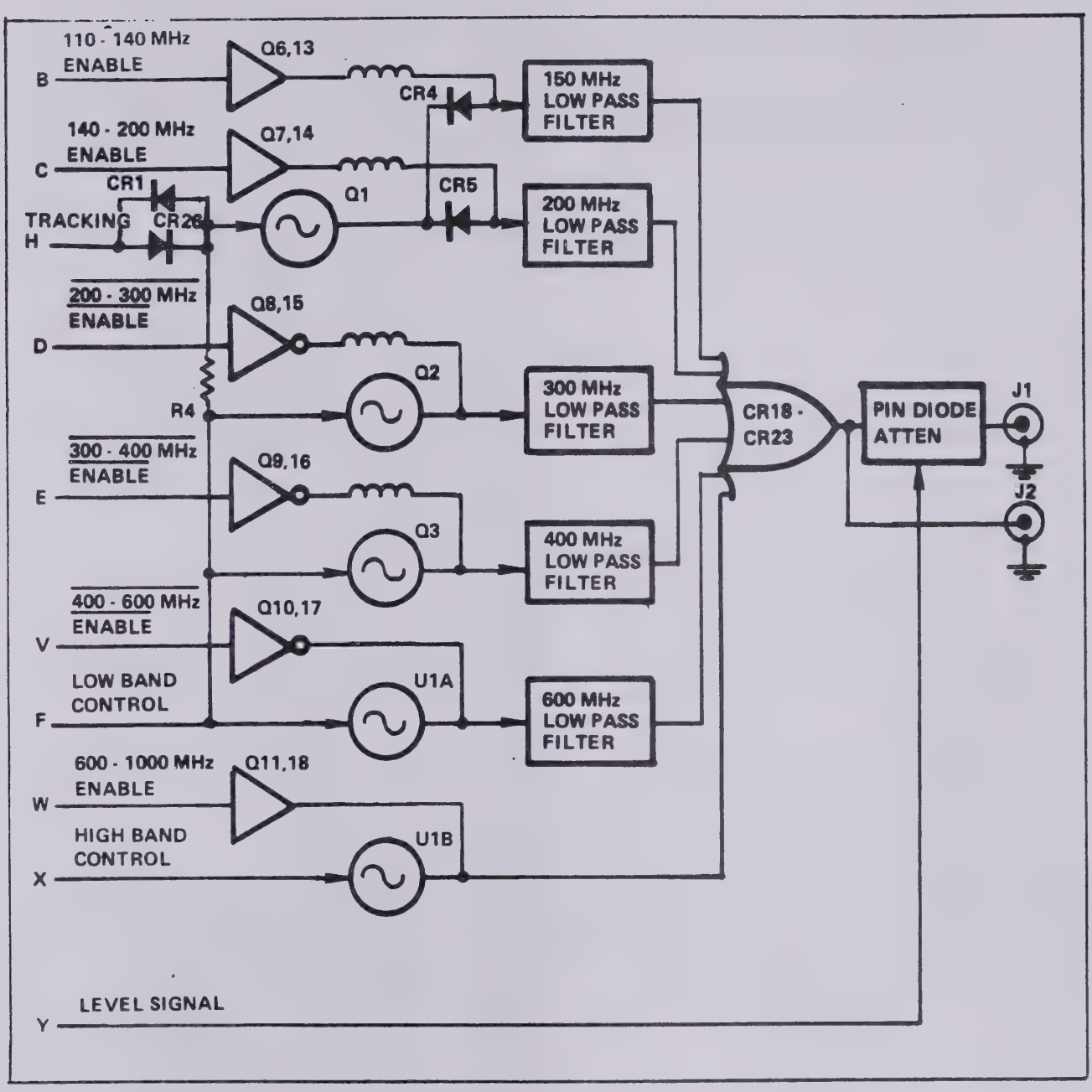


FIGURE 4-6 SOURCE 5 FUNCTIONAL BLOCK DIAGRAM

(RCVR ENABLE) signal which will provide a 10 MHz offset of the Synthesizer output when it is used as a Local Oscillator in the Received Mode. Figure 4-7 provides a Functional Block Diagram of the Control Logic Assembly operation.

The Logic PCB Assembly outputs a 12 line 10^6 through 10^8 BCD program to the Divide-By-N PCB Assembly A4A10. Also generated are the VCO ENABLE signals to the Source 4 and Source 5 Assemblies (A4A11 and A4A13), the Source 4 X2 MULT signal, the 400 MHz REF ENABLE and the LEVELER SWITCH signal to the Amplifier Assembly A4A14.

The 1-2-4-8 BCD Frequency code is applied as a compliment format to the three 4-bit TTL latches (U4,U5 and U6) data inputs. When the 10^6 STROBE Is applied to the 10^6 latch (U4) the BCD data present at the inputs is transferred to the $\overline{Q}$ outputs as a true when the strobe goes high. When the strobe goes low the data (that was present at the inputs at the time the transition occured) is retained at the $\overline{Q}$ output as its complement (true). The 10^7 latch (U5) and the 10^8 latch (U6) function is a like manner except that the 10^8 latch (U6) outputs both complementary and true (Q and $\overline{Q}$) data.

Transistors Q1 through Q11 function as TTL to ECL translators and feed the B inputs of the 10^6, 10^7, 10^8 NBCD (natural binary coded decimal) adders (U1,U2 and U3). These adders are CMOS IC's operated at -5.2V (V_{SS}) and ground (V_{DD}) to allow their outputs to be ECL compatable with the Divide-By-N PCB Assembly A4A10 logic.

The codes applied to the adders (U1,U2 and U3) A inputs by hard wiring and the RCVR ENABLE signal correspond to the 9's compliment of 1 when in the RCVR mode and to the 9's compliment of 11 when in the $\overline{\text{RCVR}}$ Mode. The adding of the 9's compliment is equivalent to subtracting in BCD arithmatic. Thus, the output BCD ÷N code is programmed to a frequency that is 1 MHz (RCVR) or 11 MHz (RCVR) lower than the Frequency switch settings. This frequency offset is required so that the Source 4 difference frequencies will be correct.

The 10^6 4-bit latch (U6) BCD outputs are decoded by logic gates U8A,U8C,U8D and U7A to allow determination of the <140 MHz and >400 MHz frequency selection.

Integrated circuit U13 is a TTL 4-bit BCD to 10-line Decimal decoder. Its logic allows full decoding of valid input data that ensures that all the decimal outputs will remain off for any invalid input condition. The BCD 4-bit input is supplied from the Q outputs of the 10^8 latch U6. The 1 of 10 decimal outputs are applied to the gating logic to allow generation of the VCO enable signals and Synthesizer control functions.

The gating logic generates the enable and control signals by identifying the 10^8 decimal outputs of the U3 decoder. Table 4-8 provides a listing of the Logic PCB Assembly outputs as to function and routings.

TABLE 4-8 LOGIC ASSEMBLY OUTPUT CONTROL SIGNALS

A4A9 ASSEMBLY PIN NUMBER	FUNCTION	TO ASSEMBLY 1 PIN NUMBER
5	10^6 BIT 1	A4A10-E
4	10^6 BIT 2	A4A10-D
3	10^6 BIT 4	A4A10-C
2	10^6 BIT 8	A4A10-B
14	10^7 BIT 1	A4A10-R
15	10^7 BIT 2	A4A10-S
12	10^7 BIT 4	A4A10-N
13	10^7 BIT 8	A4A10-P
8	10^8 BIT 1	A4A10-J
11	10^8 BIT 2	A4A10-M
6	10^8 BIT 4	A4A10-F
7	10^8 BIT 8	A4A10-H
S	100-140 MHz SOURCE 5 ENABLE	A4A13-C
16	140-200 MHz SOURCE 5 ENABLE	A4A13-B
17	100-200 MHz SOURCE 4 ENABLE	A4A11-C
W	400-600 MHz SOURCE 5 ENABLE	A4A13-V
R	400-500 MHz SOURCE 4 ENABLE	A4A11-4

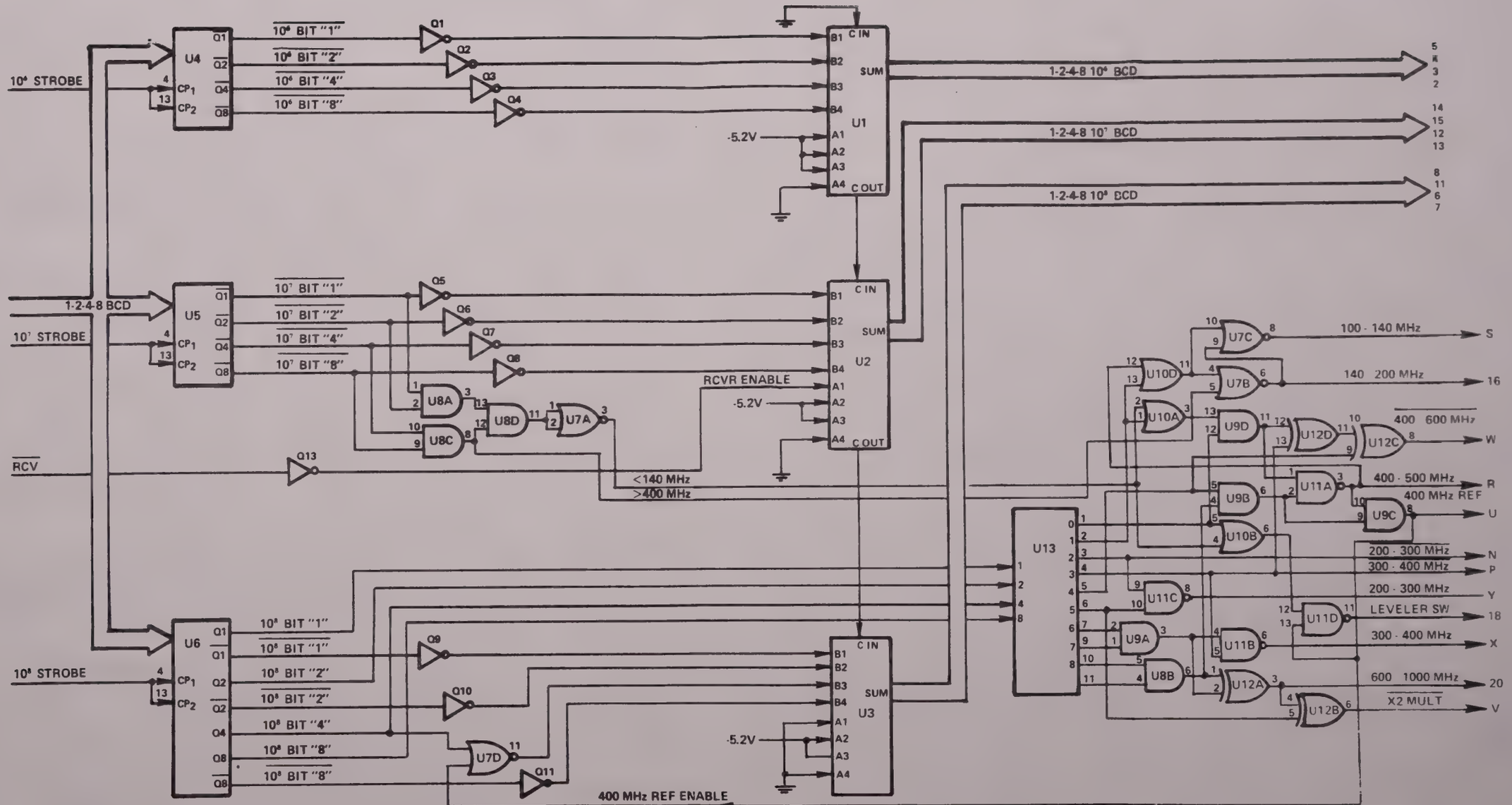


FIGURE 4-7
FUNCTIONAL BLOCK DIAGRAM
CONTROL LOGIC ASSEMBLY

TABLE 4-8 LOGIC ASSEMBLY OUTPUT CONTROL SIGNALS (Cont'd)

A4A9 ASSEMBLY PIN NUMBER	FUNCTION	TO ASSEMBLY 1 PIN NUMBER
U	400 MHz REF AMPLIFIER ENABLE	A4A8-12
18	LEVELER SWITCH	A4A14-X
N	200-300 MHz SOURCE 5 ENABLE	A4A13-D
P	300-400 MHz SOURCE 5 ENABLE	A4A13-E
Y	200-300 MHz SOURCE 4 ENABLE	A4A11-F
X	300-400 MHz SOURCE 4 & PHASE DETECTOR ENABLE	A4A12-B A4A11-D
20	600-1000 MHz SOURCE 5 ENABLE	A4A13-W
V	X2 MULT SOURCE 4 ENABLE	A4A11-M

4.4.8 Divide-By-N PCB Assembly A4A10

The Divide-By-N Assembly, divides the 99-498 MHz Source 4 signal by an integer (N) which is programmed by the 10^6 through 10^8 BCD from the Control Logic Assembly A4A9. The three decade ÷N Counter outputs its count to the PHase Detector (U8) where it is referenced to the 1 MHz reference or the 0.5 MHz reference. The Phase Detector (U8) outputs are then applied to the Integrator (U9) to generate the Frequency Control signal for the Source 4 VCO's and the Frequency Tracking signal for the Source 5 VCO's. Figure 4-8 provides a functional block diagram of the Divide-By-N Assemblies operation.

The Divide-By-N Counter utilizes the two modulus prescaler technique. The SOURCE 4 99-498 MHz signal is prescaled by Counter U1 (the basic mode of operation of the prescaler being ÷10). The two-modulus prescaler starts in the ÷11 mode. The logic comprised of gates U3 and latch U5 provide the control for the prescaler and its effective "Frequency Extension" of the three decade ÷N Counter (U2,U4 and U6). The Q outputs of the 10^6 N Divider U2 is gated by U3-3 and applied to the Prescaler U1 at pin 2 as the ÷11/÷10 modulus control (M). The 10^8 ÷N Divider U6 outputs are gated with the Q output of U5 pin 15, thus generating the ÷N count which is applied to the Phase Detector VAR input (U8 pin 1) via amplifier U10-4.

The Phase Detectors REF input applied to U8 pin 3 is either the 1 MHz TIME BASE via PCB pin V or the 0.5 MHz REF applied at PCB pin W wehn the X2 MULT signal at PCB pin T is present. A SHAPED 1 MHz OUT is also developed at U7-3 gate and applied to the Time Base Assembly A4A4 and the 400 MHz Reference Assembly A4A8 via PCB pin U.

The Phase Detector outputs are applied to Integrator Amplifier U9 which outputs the FREQ CONTROL signal to Source 4 Assembly A4A11 at PCB pin Y, and the FREQ TRACKING signal to the Source 5 Assembly A4A13 at PCB pin 21. When the VAR and REF signals applied to the PHase Detector are "In-phase" the Phase Detectors outputs are set to a logic high with extremely short duration low amplitude negative pulses, and "AND" gate comprised of CR3 and CR4 will output the TTL LOCK signal at PCB pin X.

4.4.9 400 MHz Reference Generator PCB Assembly A4A8

The 400 MHz Reference Generator Assembly generates the 400 MHz REF signal for the Amplifier Assembly A4A14 and the 10 MHz REF signals for the Source 3 Assembly A4A5 and the DC Discriminator Assembly A4A3. A 400 MHz VCO (Q2), a chain of divider counters U1,U2 and U3, and a phase detector U4 provides the basic phase lock loop (PPL) of the 400 MHz Reference Generator. Figure 4-9 provides a functional block diagram of the Assembly.

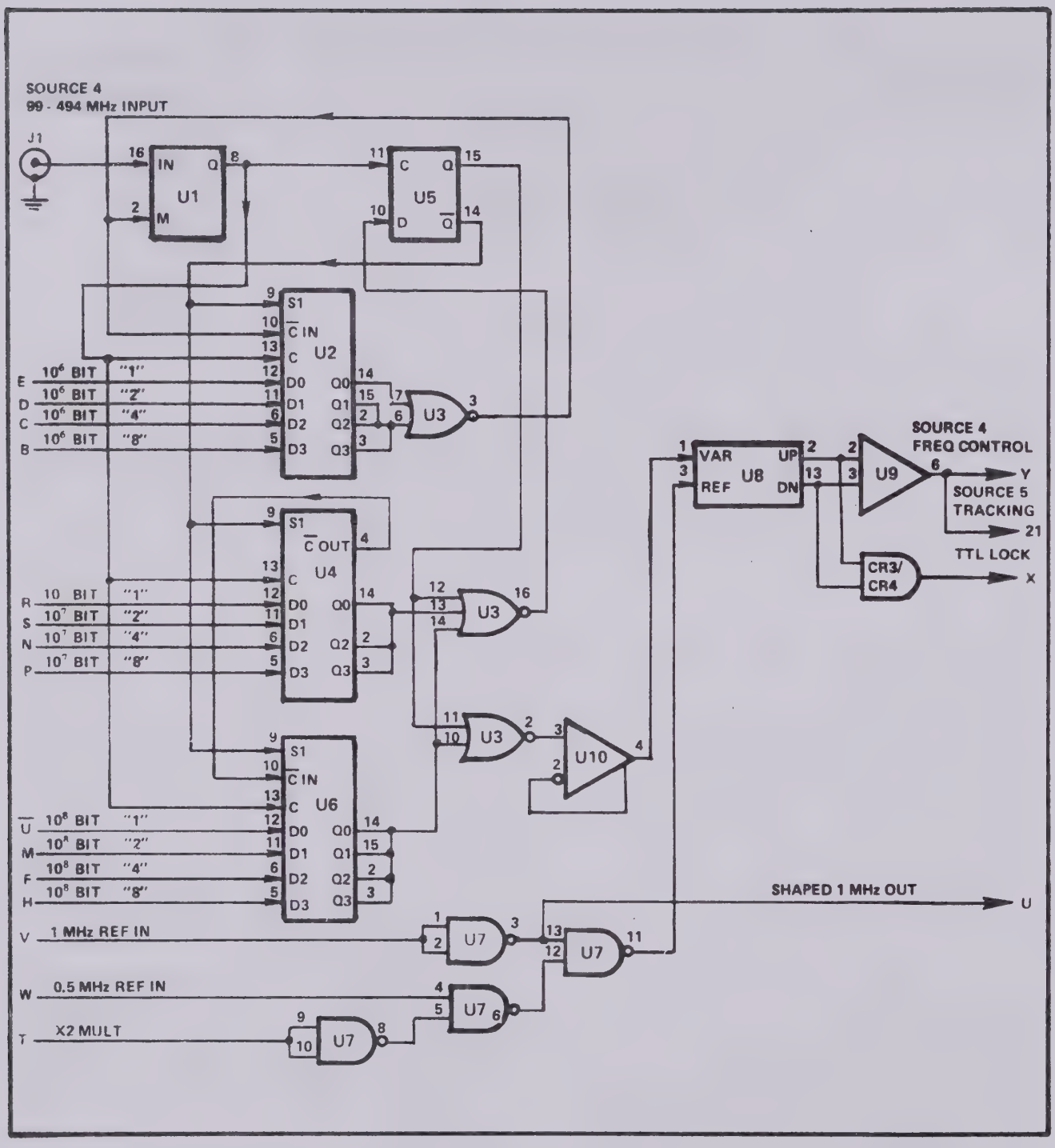


FIGURE 4-8 DIVIDE-BY-N ASSEMBLY FUNCTIONAL BLOCK DIAGRAM

The 400 MHz VCO is comprised of FET Q2 and its associated R-C-L components. VAricap CR1 provides the tuning element of the VCO and is tuned by a voltage level from the phase detector integration amplifier U5. Its output at Q2 pin 2 is coupled by capacitor C5 to the ÷10 Counter U1, and to the output amplifier Q3 by capacitor C6.

The collector of Q3 outputs the 400 MHz REF signal via a low pass filter circuit (C8, C9,L5 and L6) and a diode switch circuit (CR2 and CR3) to coax connector J1. When the 400 MHz ENABLE signal applied to PCB pin 12 is set high the diode switch consisting of CR2 and CR3 is enabled via transistors Q4 and Q5 providing an output at connector J1. Transistor Q5 also outputs the AMPL RELAY ENABLE signal to the Amplifier Assembly A4A14 via PCB pin 14.

The VCO output applied to divider chain is divided by 10 by U1 supplying a 40 MHz signal to the ÷4 counter U2. Counter U2 counts down the 40 MHz signal to 10 MHz. The output at U2 pin 7 is applied to the Source 3 Assembly via PCB pin 16 and the DC Discriminator Assembly via PCB pin 18 as the 10 MHz REF output signals. Counter U2 also outputs a 10 MHz at U2 pin 9 to the ÷10 Counter U3 input at pin 14. Counter U2 counts down the 10 MHz to 1 MHz and outputs it at U3 pin 8 to the Phase Detectors VAR VAR input (U4 pin 3).

The Phase Detector compares the phase difference of the 1 MHz REF applied to its REF input (U4 pin 1) with the 1 MHz VAR input, (U4 pin 3) and outputs the UP and DN resultants to Integrating Amplifier U5. Amplifier U5 generates the VCO tuning level at its output pin 6 which is applied to the VCO varicap CR1, thus providing a closed 400 MHz PPL reference to the 1 MHz time base signal. When the PLL is phased locked the outputs at U4 pins 13 and 2 are at a logic high with extremely short duration low amplitude negative pulses, which are "AND" gated by diodes CR4 and CR5 to generate the TTL LOCK signal which is applied to PCB pin 5 as a phse lock indicator output.

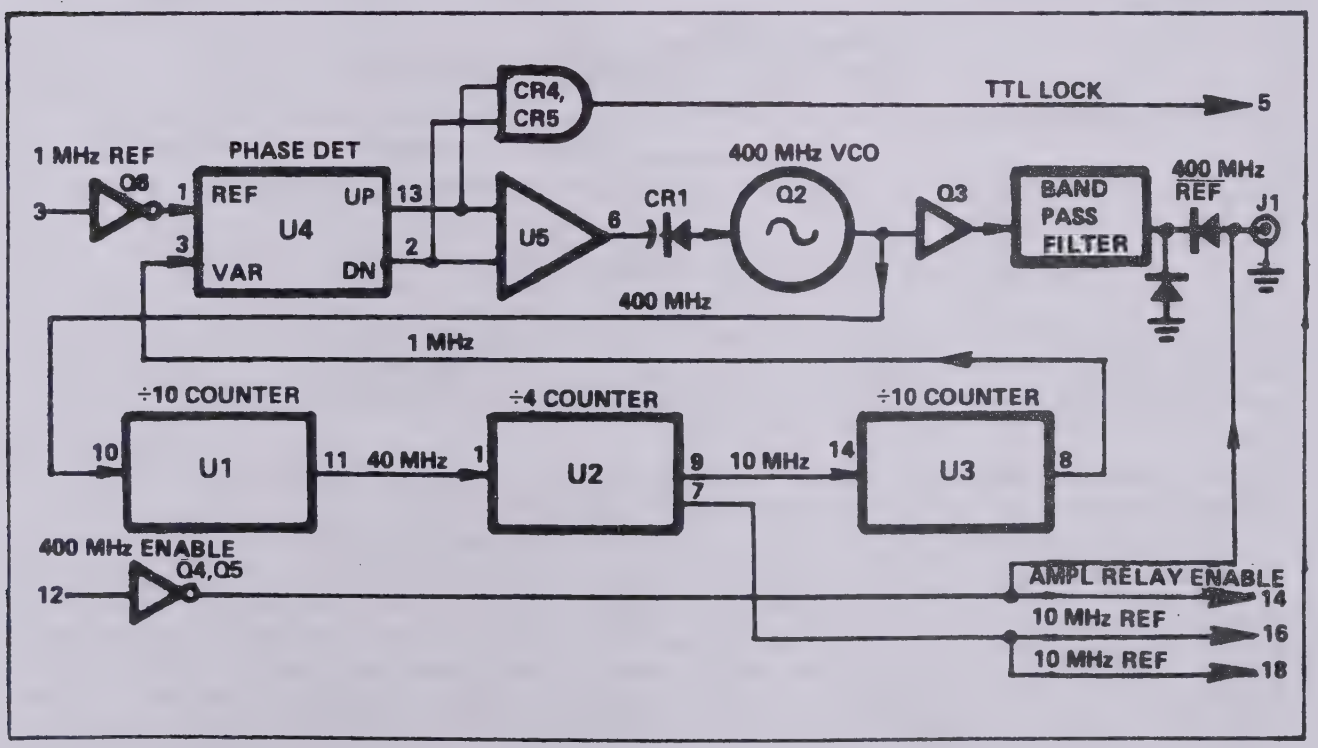


FIGURE 4-9 400 MHz REFERENCE GENERATOR FUNCTIONAL BLOCK DIAGRAM

4.4.10 Phase Detector PCB Assembly A4A12

The Phase Detector Assembly generates the HIGH BAND FREQUENCY CONTROL and the LOW BAND FREQUENCY CONTROL signals which tune the enabled VCO (one of five) of the Soruce 5 Assembly. The Source 3 Assembly 11.0000-11.9999 MHz output is compared with the Mixer Assembly A4A16 output by the phase detector circuit, and if a phase or frequency difference is detected the search generator circuit will output a tuning voltage in the form of a ramp. This ramp signal will drive the selected Source 5 VCO to the correct frequency, thus producing a phase lock. When phase lock is achieved the ECL LOCK signal is generated to indicate that the Synthesizers PLL's are locked and the Source 5 Assembly is outputting the desired frequency to the A4A14 Amplifier Assembly. Figure 4-10 provides a block diagram of Phase Detectors functional operation.

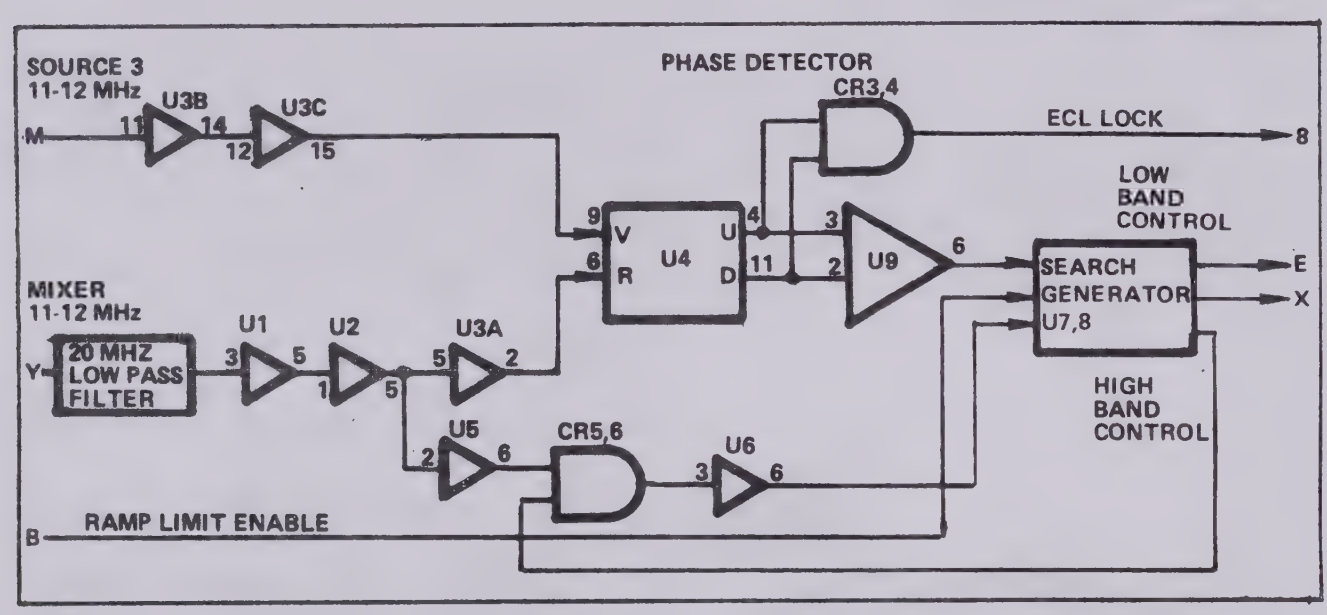


FIGURE 4-10 PHASE DETECTOR ASSEMBLY FUNCTIONAL BLOCK DIAGRAM

The 11.0000-11.9999 MHz output of the Mixer A4A16 is applied to PCB pin Y and routed to the R input of the Phase Detector via the 20 MHz Low Pass Filter (C11,C12,C20,L1 and L2) and Amplifiers U1,U2 and U3A. Amplifier U5 provides a pick-off of the Mixer signal for the Amplitude Detector circuit.

The Source 3, 11.0000-11.9999 MHz output is applied to the V input of the Phase Detector via PCB pin M input, and Amplifiers U3B and U3C.

If the frequency difference is greater than 20 MHz (which may occur when phase lock is lost) the signal at U2 pin 5 will be insufficient to allow the peak detector (CR1 and CR2) to generate a level of >0 Vdc at U5 pin 2. U5 will then saturate in the positive direction allowing CR5 to conduct. The current from diode CR5 will buck and over ride the output current of U9, thus allowing the voltage at U7 pin 6 to fall off at a rate determined by resistor R20 and capacitor C27. When the voltage at U7 pin 6 drops to less than +1 Vdc, diode CR7 will conduct, causing U6 pin 6 to saturate in the negative direction, thus turning on diode CR6. The current through CR6 will rise at a rate determined by resistor R19 and capacitor C27. Potentiometer R21 is adjusted to allow U7 pin 6 to rise to a level of +2 Vdc, and U6 pin 3 to rise

to a voltage that is greater than the level on U6 pin 2, thus causing U6 pin 6 to saturate and back bias diode CR6. The ramp generator circuit comprised of U6 and U7 will assure that phase lock will be eventually attained, even if the voltage at U7 pin 6 initially drives in the wrong direction (as occurs when the Source 5 output frequency is initially lower than the Source 4 output frequency).

When the PLL is locked, diode CR5 will be back biased (signal applied to pin Y is less than 20 MHz) and diode CR6 will be back biased (Source 5 output frequency is greater than the Source 4 output frequency). This allows the Search Generator output U7 pin 6 to be controlled by the Phase Detector U4 via Operational Amplifier U9. When the Mixer and the Source 3 inputs are in phase the Phase Detector will lock up the loop and an ECL LOCK signal will be generated by AND gate CR3,4 and applied as an output at PCB pin 8. The RAMP LIMIT ENABLE signal applied to PCB pin B is generated by the Logic PCB Assembly A4A9 to enable the ramp limit function of the Search Generator circuit, when the 300-400 MHz Source 4 VCO is enabled.

4.4.11 Mixer Assembly A4A16

The Mixer Assembly heterodynes the Source 4 Assembly A4A11, 99-988 MHz output with the Source 5 Assembly A4A13, 110.0000-999.9999 MHz output to generate an IF output of 11.0000-11.9999 MHz which is applied to the Phase Detector Assembly A4A12. The Source 4 input is applied to coax connector J1 and amplified by the IC wide band RF Amplifier U1 and then applied to the IC Mixer U2 at its input pin 2. The Source 5 input is applied to the IC Mixer input pin 8 via coax connector J3. The IF output at U2 pins 3 and 4 is connected to coax connector J2 which supplies the 11.0000 - 11.9999 MHz signal to the Phase Detector Assembly A4A12.

4.4.12 Amplifier PCB Assembly A4A14

The Amplifier Assembly provides three functions; it provides the leveling and amplitude modulation of the Synthesizer output and the heterodyning of the Source 5 output with the 400 MHz Reference Signal. Figure 4-11 provides a functional block diagram of the Amplifier Assembly operation.

The Source 5, 110.0000-1009.9999 MHz output is applied to coax connector J1 and then routed via a PIN Diode Attenuator circuit (CR1,2 and 3) to the wide band IC Amplifier (U1). Transistors Q1 and Q2 and their associated components constitute a class A amplifier circuit which outputs to coax relay K1. When the 400 MHz Reference Relay is deenergized, the leveled 110.0000-999.9999 MHz Synthesizer output is routed directly to the output coax connector J3 and J4. Coax connector J3 is the Synthesizers RF output and is applied to the Output Attenuator Assembly U1 via A4J21. Coax connector J4 is the local oscillator output and is applied to the L.O. Switch Assembly A4A18.

When the Synthesizer is selected to operate below 110 MHz the Source 5 output frequency is 400 MHz higher than the frequency selection. The Source 5 signal applied to coax connector J1 is routed via the PIN Diode Attenuator and amplifier by U1,Q1 and Q2, and then applied to the Mixer at U4 pin 1 via PIN Diode CR4. PIN Diode CR4 is enabled by the RELAY SWITCH SIGNAL applied to PCB pin Y (+15V level) whenever the frequency settings are selected for 110 MHz of less. The +15V RELAY SWITCH SIGNAL also pulls Relay K1 via transistor Q3 output from coax connectors J3 and J4, and provides collector current to enable transistor Q10. Transistor Q10's input is the 400 MHz REF signal from PCB Assembly A4A8 and outputs to the Mixer U4 pin 8. The frequency difference output of the Mixer U4 at pins 3 and 4 is a signal having a frequency of the thumbwheel switch settings, which is applied to a dc coupled amplifier consisting of U5,Q7,Q8 and Q9. Feedback capacitor C27 assures that U5 responds only to dc and extremely low frequency ac signals. The amplifier's ac gain is stabilized by negative feedback from Q9's collector to the base of Q8 via the network consisting

of C30,R42,R43 and R46. Transistors Q9's output is applied to coax connectors J3 and J4 via the normally open coax contact of Relay K1. Relay K1's normally open auxillary contact supplies collector current to Q9 when the relay is enabled.

The r-f output at connector J3 is peak detected by diode CR8. The detected signal is then applied through diode CR10 to U2 pin 3. Operational Amplifier U2 compares the detected output envelope with the signal applied to PCB pin T. This signal (AM MOD) is a negative voltage level set by the Front Panel Level vernier control, which includes the amplitude modulation envelope if AM Modulation has been selected. U2's output (pin 6) controls the PIN Attenuator comprised of diodes CR1,2 and 3. U2 pin 6 is also connected to the PCB output pin B which will extinguish the Front Panel LEVELED indicator when U2 saturates, to indicate that maximum PIN Attenuation has been reached. U2 pin 6 is also coupled to integrating amplifier U3 input pin 3 via resistors R31 and R32. U3's integrating time constant is determined by R31 and C18. The output of U3 at pin 6 is applied to the PIN Attenuator on the Source 5 PCB Assembly A4A13 via PCB pin C as the SOURCE 5 LEVELING SIGNAL.

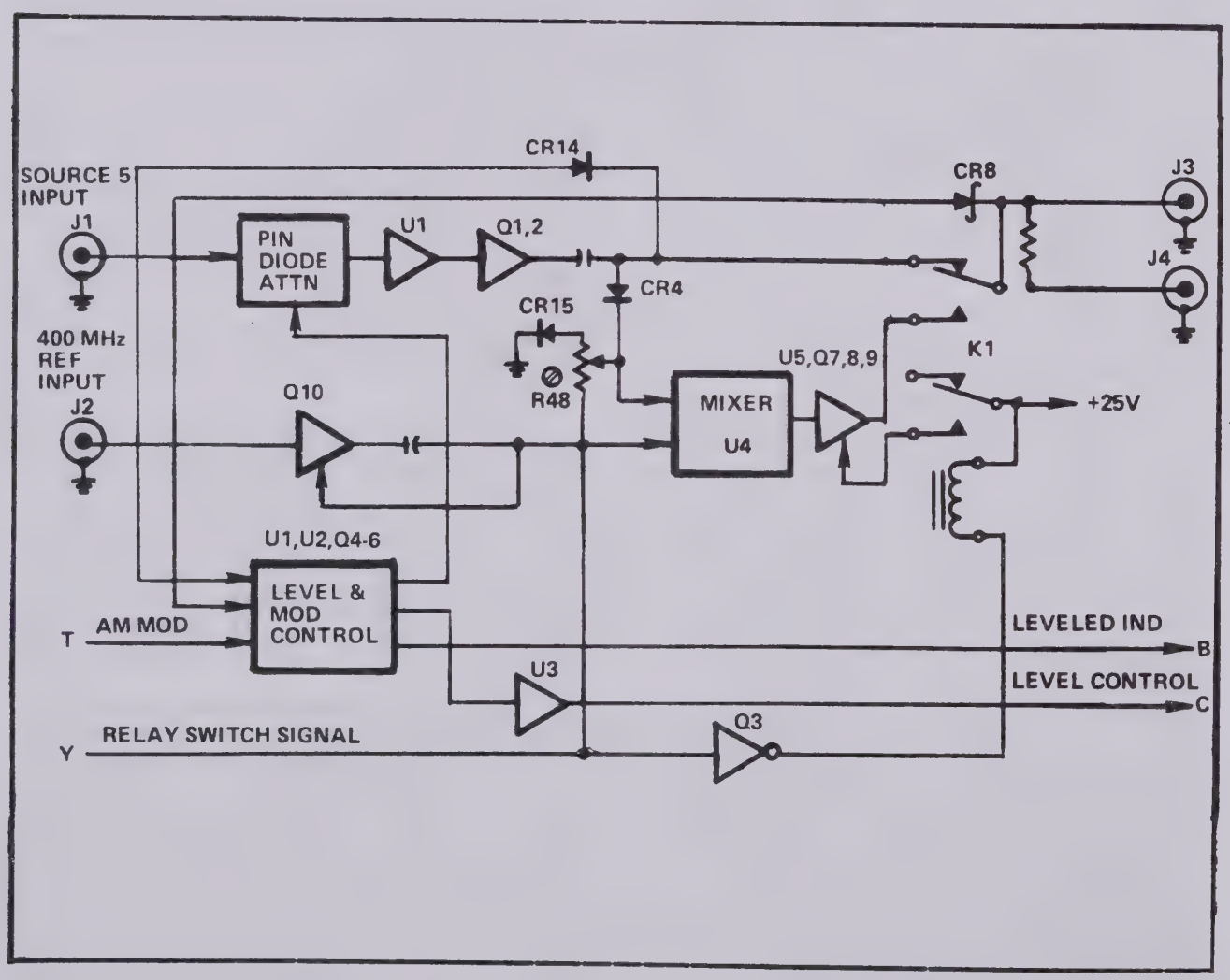


FIGURE 4-11 AMPLIFIER ASSEMBLY FUNCTIONAL BLOCK DIAGRAM

4.4.13 Time Base Generator PCB Assembly A4A4

The Time Base Generator Assembly generates the 1-2-4-8 BCD Frequency Code and the 10^2 through 10^8 decade Strobes. The selection of the Synthesizers frequency is by the Frequency Switch Assembly A3A1, which interfaces with the Time Base Generator vi via the A-G-C Strobes and returns the BCD code frequency selection. The Time Base Generator also generates the 0.5 MHz, 10 kHz and 1 kHz Reference signals for the Synthesizer's operation. Figure 4-12 provides a functional logic diagram of the Time Base Generators operation.

The 1 MHz Reference from the Reference Oscillator Assembly A5 via the shaper circuit located on PCB Assembly A4A10, is applied to the PCB pin 15 and translated to a TTL square wave by transistor Q1, and then routed via a CMOS buffer/inverter U1A to the Time Base Counter input at U2A pin 2. The Time Base Counter is configured as a four decade BCD count chain and outputs the following signals as the indicated circuit elements and pin callouts.

1. 0.5 MHz Reference (U1B pin 4).
2. 10 kHz Reference (U2B pin 13).
3. 1 kHz Reference (U1E pin 12 and U1F pin 15).
4. 1 kHz Modulation (CR2 and CR3).
5. A Strobe (U3B pin 11).
6. B Strobe (U3B pin 12).
7. C Strobe (U3B pin 13).

The three Strobes are applied to the Frequency Switch Assembly A3A1 or the Frequency Control Assembly A3A4, for encoding to the selected frequency and returned as the BCD Frequency 1-2-4-8 Code. This BCD Frequency code returned at PCB pins 8,11,M and 12 is buffered by CMOS inverters U4A through U4D and TTL inverters U5A through U5D and then supplied as outputs at PCB pin X,V,R and S to the Source 2 A4A5 and Control Logic A4A9 Assemblies.

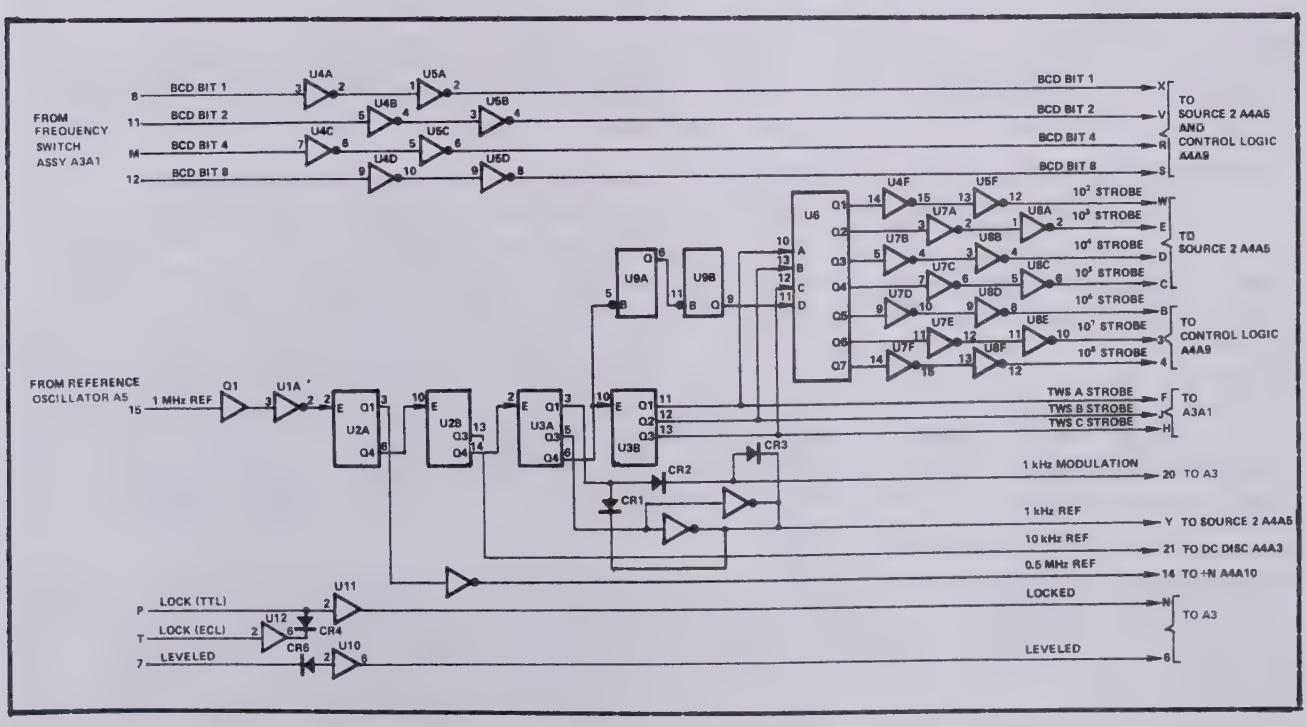


FIGURE 4-12 TIME BASE GENERATOR ASSEMBLY LOGIC DIAGRAM

The A, B and C Strobes generated by U3B are also applied to the 10^2 through 10^8 Strobe Generator U6, at its A-B-C BCD inputs. The D BCD U6 input is generated by the dual one-shot multivibrator U9A and U9B which is triggered by the Q4 output of U3A Time Base Divider (U3A pin 6). Integrated Circuit U6 is a TTL BCD-to-Decimal Decoder, which outputs the 10^2 through 10^8 Strobe signals. These decade strobes are buffered and applied as outputs to the Control Logic A4A9 and the Source 2 A4A5 Assemblies. (Refer to Figure 4-12 for the PCB output pinning callouts.)

The LOCK (TTL) and LOCK (ECL) signals that are applied to PCB pins P and T respectively, aare "AND"ed by Drivers U11 and U12 to output the LOCKED signal at PCB pin N. The LEVELED signal applied to PCB pin 7 from Amplifier Assembly A4A14 is amplified by Driver U10 and outputs as the LEVELED signal at PCB pin 6. When the voltage at PCB pin 7 is less than -7 Vdc, diode CR6 will conduct causing U10 pin 6 to saturate in the + direction, which will extinguish the LEVEL Indicator. When the voltage at PCB pin 7 is greater than +8 Vdc diode CR7 conducts and diode CR8 is reversed biased. This causes U10 to oscillate at a rate determined by C8.R19 and R20 and will inturn flash the LEVEL indicator on and off. When the voltage at PCB pin 7 is between -7 Vdc and +8 Vdc, neither CR6 or CR7 conducts and U10 pin 6 will saturate in the - direction, thus illuminating the LEVEL indicator.

4.4.14 Local Oscillator Switch PCB Assembly A4A18

The Local Oscillator Switch Assembly is a non-plug-in PCB Assembly enclosed in an RFI shielded container. It is comprised of a diode RF switch and a high pass filter. The L.O. Output from the Amplifier Assembly A4A14 coax connector J4 is applied to its input feed through connector. The Switch is enabled when the RCVR ENABLE signal is set at a -15V, and disabled when the RCVR ENABLE signal is set to a +15V, which controls the bias on the 5 pin diodes, and CR7 on the Amplifier PCB Assembly. The output feed through connector is coax cabled to the Synthesizer L.O. OUT coax connector J27. When configured in the Signal Generator, the RCVR ENABLE is hard wired to +15V, thus inhibiting the L.O. receiver function.

4.5 A3A1, A3A2, A3A3 and A5, DETAILED CIRCUIT DESCRIPTIONS

The following subparagraphs provide the detailed theory of operation and circuit analysis at the circuit level. These circuit descriptions are referenced to the schematic diagrams of the appropriate assembly located in Chapter 7 of this manual.

4.5.1 Frequency Switch PCB Assembly A3A1

The Frequency Switch receives its A, B and C address signals from the Time Base Generator Assembly A4A4 via Connector/Plug Assembly J9/P9 pins 2,4 and 7, respectively. This three bit binary input is decoded to an octal (one-of-eight) code by integrated circuit U1. These U1 outputs are the 10^2 through 10^8 Frequency Switch Address Strobes which are applied to the 7 Frequency switch elements at their common connections (pins Y). Each of the Frequency Switch elements outputs a BCD 1-2-4-8 code which is equal to its "dialed in" frequency setting. The 7 Frequency Switch element BCD outputs are combined by the "OR" gates comprised of diodes CR1 through CR28 to generate the 1-2-4-8 BCD Frequency code which are returned to the Time Base Generator Assembly A4A4 via Connector/Plug Assembly J9/P9 pins 5,8,9 and 6, respectively.

4.5.2 Display PCB Assembly A3A2

The Display PCB Assembly plugs into the Mother PCB Assembly A3 via an edge connector and interfaces with the Front Panel window to provide display of the modulation in AM percentage or FM deviation in kHz on a four digit seven segment LED display.

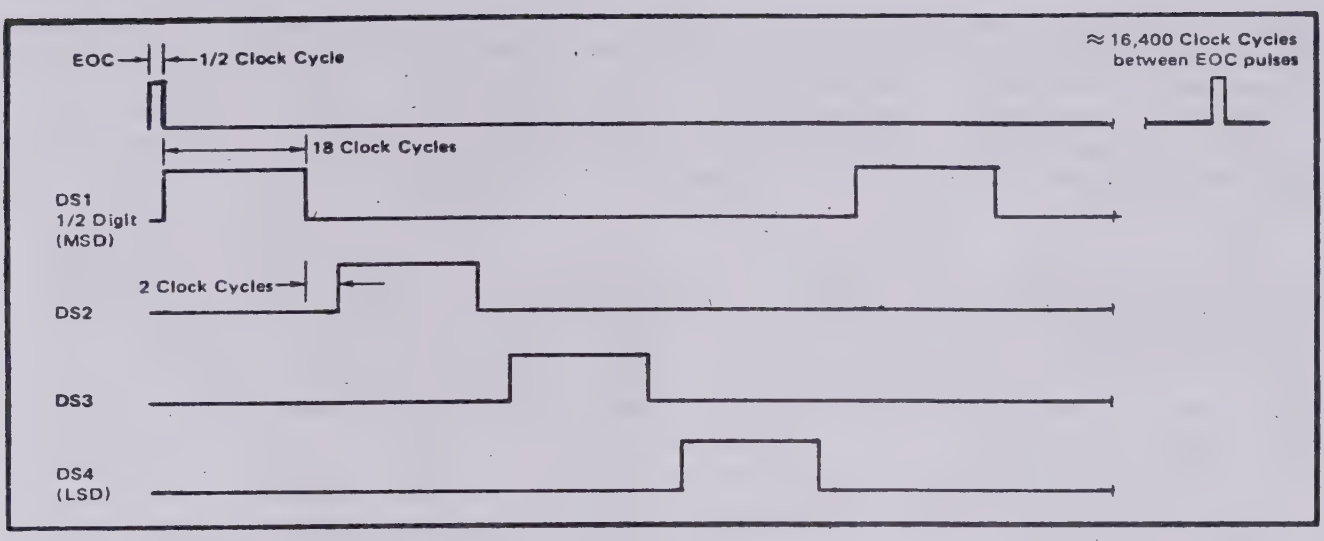


FIGURE 4-13 DIGIT SELECT TIMING DIAGRAM

Three LED annunciators (DS5,DS6 and DS7) interface with the Modulation Control PCB Assembly A3A3 to provide indication of the selected modulation mode and unit of measurement of the four digit display via the Front Panel window. Two LED status indicators DS9 and DS10 provide LOCK and LEVEL status of the Synthesizer operation.

The INPUT signal, an analog voltage level that relates to the percentage (%) of AM or the deviation in kHz of FM, is applied to A3A2 edge connector pin 20, and routed to pin 3 of A3A2U1 the Vx input of the 24 pin DVM DIP IC.

Integrated Circuit U1 is a type MC14433 CMOS 3-1/2 digit A/D converter that functions as a complete digital voltmeter system, less the display circuits. A reference voltage of +2.000 ±5% is developed by Zener VR1 and the voltage divider network comprised of R1 through R4, which is applied to U1 pin the **VREF** input. U1 pin 1 (**VAG**) is connected to ground to provide a 0V reference for the Vx and **VREF** inputs. U1 pin 24 (**VDD**) is placed at +5.10V ±5% by Zener Diode VR2.

The A/D converter of U1 performs a ratiometric convertion using a modified dual slope integrationtechnique. It compares the input analog level at Vx and measures it as a ratio of the reference voltage at **VREF**.

The external components connected to the 24 pin DVM DIP U1 provides for operational parameters of the DVM system. Resistor R6 and capacitor C5 connected to pins 4,5 and 6 provide for the setup of the A/D conversion factors, the 470 kΩ value of R6 determines the integrator conversion cycles which is ≈250 ms. Capacitor C4 connected between pins 7 and 8 is the offset correction capacitor which provides the systems out-to-zero operation to compensate the offset voltages of the internal amplifiers and comparators. Resistor R7 connected between pins 10 and 11 determines the frequency of the internal clock oscillator, the 330 kΩ value of R7 results in a clock frequency of ≈66 kHz.

Integrated Circuit U1 outputs a digit select as logic high when the respective digit is selected on pins 16 through 19. The MSD on pin 19 (1-2 digit) turns on immediately after the EOC pulse (pin 14) followed by the remaining digits, sequenced from MSD to LSD. An inter-digit blanking time of two clock periods is provided to ensure that the BCD output data has settled. The multiplex rate is equal to the clock frequency ÷80 or ≈0.8 kHz. Figure 4-13 provides a timing diagram of the digit select signals relative to the EOC signals.

The data output is BCD format contains 3-1/2 digits and is presented as a 1-2-4-8 logic high on pins 16 through 19. The BCD data is applied to U2 a type 742S247 BCD-to-seven Segment Decoder/driver. IC U2 receives its 1-2-4-8 data inputs on pins 7, 1,2 and 6, respectively, and outputs the seven segment drive to the four Seven segment LED Display elements DS1,DS2,DS3 and DS4. Display element DS1 the 1-2 digit MSD has its c and b inputs feed in parallel via resistors R16 and R17 from the b output of U2 (pin 12) thus generating a display of a digital "1".

When the DVM system is overranged, the display will flash on and off at a rate of ≈0.5 seconds. This is done by connecting the ECO (U2 pin 14) and $\overline{OR}$ (U2 pin 9) and counting it down by a factor of two (÷2) by D flip-flop U3 and blanking the display using the $\overline{BI}$ input of the BCD-to-Seven Segment Decoder (U2 pin 4).

When the CW mode is selected a logic low CW is set on the $\overline{BI}$ input of U2 to inhibit the Seven Segment drive to the four LED display elements.

4.5.3 Modulation Control PCB Assembly A3A3

The Modulation Control PCB provides two major functions; the routing, selection and conditioning of the modulation signals, and the generation of the MOD SIGNAL for the digital display of the modulation characteristics.

The INT MOD signal is a 1 kHz digital clock that is sourced from the Synthesizer at A4 pin 5 and applied to A3A3 pin A via Mother PCB transistor A3Q2 and the Front Panel Panel INTERNAL Modulation control R26. The INT MOD signal input is then applied via potentiometer R19 (INT) to the sine wave shaper circuit comprised of U2,Q2 and their associated RC components. The 1 kHz sine wave is coupled by capacitor C3 to U2 pin 10 and the source of FET Q7.

The circuit comprising U2,Q4,Q5 and associated RC components provides the drive for the 1 kHz output at A3A3 pin 2 to the Front Panel 1 kHz OUT BNC connector to provide a 0 to 2V peak 1 kHz sine wave into a 50Ω load.

The EXT MOD signal is sourced from the Front Panel EXT MOD BNC connector J3 via the EXTERNAL Modulation Front Panel control R27, and applied to A3A3 pin 1 as the EXT MOD IN signal. The EXT MOD IN signal is then applied via potentiometer R15 (EXT) to the source of FET Q6.

The Front Panel MOD SOURCE switch S1 interfaces with the modulation source select logic via A3A3 pins M and K, to allow selection of the modulation source. When INT modulation is selected U2 pin 6 is pulled down via R18 to a logic low and U2 pin 3 is pulled down to a logic low via R14, which will turn on FET Q7 and turn off FET Q6 thus selecting the internal 1 kHz as the modulation source. When BOTH is selected U2 pin 6 is set to a logic low and U2 pin 3 is set to a logic high, which will turn on both FET's Q6 and Q7, thus allowing both external and internal modulation sourcing. When EXT modulation is selected U2 pin 6 and pin 3 are both set to a logic high, which will turn on FET Q6 and turn off FET Q7, thus selecting the external modulation source.

The Mother PCB ounted MODULATION MODE switch S3 interfaces with the modulation mode select gates U1 via A3A3 pins C,4 and F. When FM is selected A3A3 pin C is set to a logic high which will generate a FM command at A3A3 pin 5 by turning off transistor Q3. This FM command at A3A3 pin 5 is pulled up by a Mother PCB mounted resistor R22 to +5V and applied to the Display PCB Assembly A3A2 pin F to illuminate the FM-kHz annunciator A3A2DS5 and to the Synthesizer A4 pin 16 as an FM ENABLE signal. When CW is selected A3A3 pin 4 is set to a logic high which will generate a $\overline{CW}$ command at A3A3 pin J by turning on transistor Q2. This $\overline{CW}$ command at A3A3 pin J is

applied to the Display PCB Assembly A3A2 pin J to illuminate the CW annunciator A3A2DS7 and blank the 3-1/2 digit numerical display to indicate an unmodulated (CW) Signal Generator output. When AM is selected A3A3 pin F is set to a logic high which will turn on FET's Q9 and Q10, thus enabling the AM function and outputting the AM OUT signal at A3A3 pin 13. An AM command will also be generated as a logic high at A3A3 pin 6, which is applied to the Display PCB Assembly A3A2 pin B to illuminate the AM-% annunciator A3A2DS6.

The modulation signal selected by the modulation source logic and enabled by FET's Q6 and Q7 is applied across potentiometer R37 the DISPLAY CAL adjustment. The modulation signal is then picked off the swinger of potentiometer R26 and applied to level detection circuit comprised of A5,A6 and Q10 and their associated passive components. The level detection circuit generates an analog level that relates to the modulation characteristics (percent of modulation when AM is selected and deviation in kHz when FM is selected). The DET NULL adjustment R41 is provided to null out any offset of the level detection circuits input amplifier. The DISP NULL adjustment R55 is provided to zero the DVM display (located on the Display PCB Assembly A3A2) when no modulation is applied, thus nulling out any dc level offset of the level detector output. When AM is selected FET Q11 will turn on, thus configuring the divider network consisting of R51 and potentiometer R52 AM DISPLAY adjustment for AM percentage of modulation. The MOD SIGNAL at A3A3 pin 20 is applied to the Display Assembly A3A2 pin 20 as an analog level that is scaled to provide a DVM reading that relates to % of AM or deviation in kHz of FM.

4.5.4 Clock Oscillator PCB Assembly A5

The Clock Oscillator Assembly A5 allows Rear Panel switch selection of the 1 MHz internal oscillator or an externan source of 1 MHz, 2 MHz, 5 MHz or 10 MHz as the 1 MHz time base for the Synthesizer that is applied to coax connector A4J22.

When the Rear Panel CLOCK SOURCE switch S4 is placed in its INT position a logic low (ground) is applied to A5 pad 4, which will inhibit the external clock by setting pin 12 of Schmitt trigger U1 low. A low will also be placed on the $\overline{MR}$ of the Programmable ÷N Counter at U2 pin 10 via diode CR13, thus inhibiting its output at the BUS U2 pin 12. The 1 MHz clock from the Oscillator Assembly #053745 is applied to A5 pad 12 and routed via transistor Q2 to the Schmitt trigger input U1 pin 5. The Schmitt trigger output U1 pin 6 is applied to Schmitt trigger input U1 pin 9 and its output U1 pin 8 is applied to the pin 1 and 2 inputs of Schmitt trigger U1 which outputs at U1 pin 3 to the A1 input pin 3 of One shot M.V. U3. The One Shot M.V. Q output (U3 pin 6) is applied to the Rear Panel 1 MHz OUT BNC connector J5 via A5 pad 6, and its complement at U3 pin 1 the $\overline{Q}$ output is applied to the Synthesizer T.B. INPUT A4J22 via A5 pad 11. The pulse width of the 1 MHz outputs of U3 is 0.5 µs and is determined by the timing capacitor and resistor C5 and R13.

When the Rear Panel CLOCK SOURCE switch S4 is placed in its EXT position a logic low (digital ground from A5 pad 5) is set on A5 pad 3, which will inhibit the internal 1 MHz Oscillator source by placing a logic low on Schmitt trigger U1 pin 4 input. A ground is also supplied to the Rear Panel EXT CLOCK MHz switch S5 to allow the switch selected external clock rate to be programmed into the Programmable ÷N Counter U2. When an external clock is applied to the Rear Panel EXT CLK IN BNC connector J6 and capacitor coupled via C1, transistor Q1 will levle translate it to a TTL logic level and input the clock to Schmitt trigger NAND gate U1 at pin 13. U1 pin 11 outputs to Schmitt trigger input U1 pin 10 which outputs at U1 pin 8 to the Programmable ÷N Counter CLK and GATE inputs U3 pins 6 and 4.

When the EXT CLOCK MHz siwtch S5 is placed in its 1 MHz position, and the CLOCK SOURCE switch S4 is placed in its EXT position a logic low (digital ground) is set on U2 pin 10 (MR) via diode CR5 to inhibit the Programmable ÷N Counter. The external 1 MHz clock is applied to the A1 input of the One Shot M.V. (U3 pin 3) via Schmitt trigger NAND gate U1-3, to trigger the One Shot at a 1 MHz rate.

When the EXT CLOCK MHz switch is placed in its 2 MHz position and the CLK SOURCE switch is placed in its EXT position, a logic low is set on the P_0, P_2 and P_3 inputs of the Programmable ÷N Counter (U2 pins 5,14 and 2). The Counter thus programmed for a ÷2 will accept a 2 MHz external clock and output a 1 MHz clock at its BUS output pin 12, which is then applied to the A2 input (U3 pin 4) of the One Shot M.V. to trigger it at a 1 MHz rate.

When the EXT CLOCK MHz switch is placed in its 5 MHz position and the CLK SOURCE switch is placed in its EXT Position, a logic low is set on the P1 and P2 inputs of the Programmable ÷N Counter (U2 pins 11 and 14). The counter thus programmed for ÷5 will accept a 5 MHz external clock and output a 1 MHz clock at its BUS OUTPUT pin 12, which is then applied to the A2 input (U3 pin 4) of the One Shot M.V. to trigger it at a 1 MHz rate.

When the EXT CLOCK MHz switch is placed in its 10 MHz position and the CLOCK SOURCE switch is placed in its EXT position, a logic low is set on the P0 and P2 inputs of the Programmable ÷N Counter (U2 pins 5 and 14). The counter thus programmed for a ÷10 will accept a 10 MHz external clock and output a 1 MHz clock at its BUS output pin 12, which is then applied to the A2 input (U3 pin 4) of the One Shot M.V. to trigger it at a 1 MHz rate.

The open assignments on the A5 PCB called out for diodes CR14 through CR18 is provided to allow programming the ÷N Counter, for count down of internal optional time base oscillators having different output frequencies. U2 can be programmed to divide any number (N) from 0 through 15. Table 4-9 provides the ÷N programming format for IC A5U2 which is an MC5018 Programmable Modulo-N Counter.

TABLE 4-9 A5U2 PROGRAMMING FORMAT

÷N	P0 (pin 5)	P1 (pin 11)	P2 (pin 14)	P3 (pin 2)
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1
10	0	1	0	1
11	1	1	0	1
12	0	0	1	1
13	1	0	1	1
14	0	1	1	1
15	1	1	1	1

CHAPTER 5
MAINTENANCE AND CALIBRATION

5.1 INTRODUCTION

This chapter provides information on alignment and calibration procedures, routine maintenance, and troubleshooting techniques.

Whenever the Signal Generator requires factory service, the nearest Motorola representative should be contacted. He can provide field service at your location or arrange factory return when necessary. Address all inquiries on operation, service or application to your nearest Motorola Communications Division Sales/Service office listed in the front matter of this manual. Specify the model and complete serial number in all correspondance.

5.2 CALIBRATION AND TEST EQUIPMENT

Table 5-1 lists the test equipment required for the test and alignment procedures. Alternate equipment with equivalent characteristics may be used when the recommended types are not available.

TABLE 5-1 RECOMMENDED TEST EQUIPMENT

Frequency Counter Systron-Donner 6053	c to 3GHz 7-digit display.
Power Meter Systron-Donner 4020	1 MHz to 12.4 GHz -40 dBm to +10 dBm.
Service Monitor Main Frame Motorola R-1200A with SLN-6352 Wideband Mixer, RTC-4000A Deviation Meter and SLN-6381A Audio Frequency Synthesizer plug-in modules.	Refer to the R-1200A manual for specifications.
Spectrum Analyzer Systron-Donner 4808	10 kHz to 1.8 GHz.
Oscilloscope Tektronix 7704 with 8A19 and 7B71 plug-in modules	250 MHz bandwidth main frame, with pro-proper sweep and vertical plug-in modules.
Function Generator Systron-Donner 405	0 to 11 MHz sinewave output 4V peak-to-peak.
Frequency Standard Hewlett Packard HP105A/B	1 MHz $<1 \times 10^{-10}$ short term stability.
Digital Multimeter Systron-Donner 7003	ac and dc voltage and current ±0.1% 3-1/2 Digit.
RF Power Amplifier Hewlett Packard HP8447C	30-300 MHz +17 dBm output.
Power Supply Systron-Donner HH32-1.5	0 to 20 Vdc.

5.3 REFERENCE OSCILLATOR CALIBRATION PROCEDURE

The frequency accuracy of the Frequency Generator signal is related to the accuracy of the reference oscillator. The calibration period for the reference oscillator

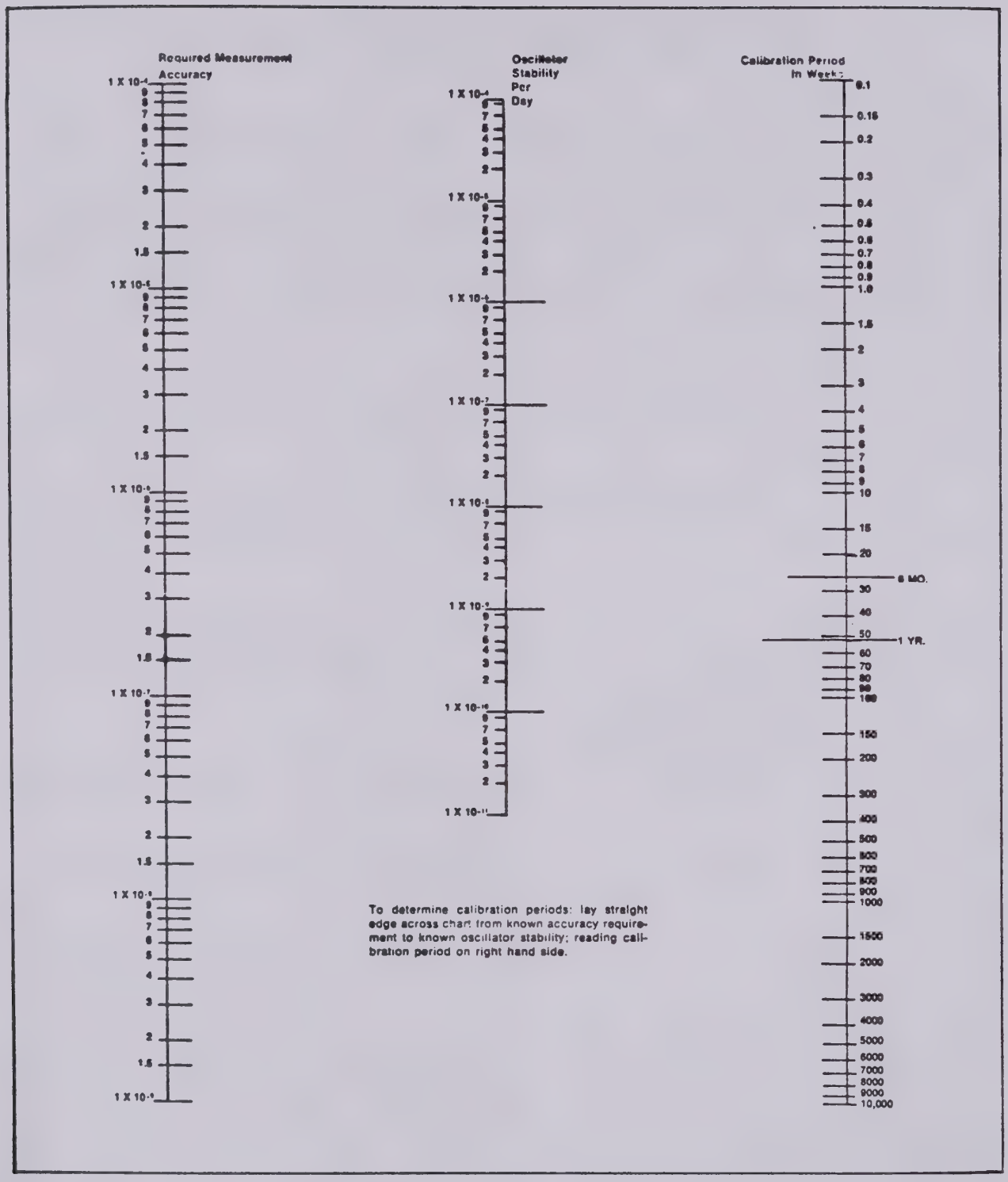

Required Measurement Accuracy
Oscillator Stability Per Day
Calibration Period In Weeks
To determine calibration periods: lay straight edge across chart from known accuracy requirement to known oscillator stability; reading calibration period on right hand side.
6 MO.
1 YR.

FIGURE 5-1 REFERENCE OSCILLATOR CALIBRATION PERIODS

is determined by two factors; the required measurement accuracy and the reference oscillators stability and aging rate. Figure 5-1 is a chart that will allow the service technican to determine the required calibration period. To find the required calibration period, lay a straight edge across the chart from the required measurement accuracy to the reference oscillator stability then read the calibration period off the right hand scale.

Three different reference oscillators which may be installed in the Signal Generator have different aging rates and temperature stability specifications. Check the type or reference oscillator and determine its specifications.

If the reference oscillator is of an oven type the Signal Generator should be plugged into its power source and allowed to run uninterrupted for at least 72 hours prior to calibration. It is recommended that the Signal Generator be calibrated at an ambient temperature of +20°C (+68°F).

To calibrate the reference oscillator use a 1 MHz Frequency Standard with an accuracy of at least 1×10^{-10} short term stability and an oscilloscope having a sweep rate of 0.01 µs/cm.

1. Apply the 1 MHz output of the Frequency Standard to the external trigger connector of the oscilloscope, set the sweep rate to 0.01 µs/cm and select the external trigger mode.

2. Place the Signal Generator's Rear Panel 1 MHz INT/EXT switch in the INT position, and connect the Rear Panel 1 MHz OUT BNC connector to the vertical input of the oscilloscope.

3. Adjust the reference oscillators adjustment(s) for a near stationary waveform on the oscilloscope, then readjust for minimum drift of the waveform.

4. Monitor the oscilloscope noting the rate of drift. The amount of error as referenced to the Frequency Standard can be calculated by the drift rate. A 1 cm/s drift indicates an error of 1 part in 10^{-8} (0.01 PPM).

5.4 INTERNAL ADJUSTMENT LOCATION

All field level adjustments are performed via five adjustment ports on the bottom cover of the Synthesizer Assembly A4, by eight potentiometers located on the Modulation Control PCB Assembly A3A3 and one potentiometer located on the Mother PCB Assembly A3. Figure 5-2A and 5-2B depict these adjustment as to locations, function and reference designator.

5.5 MODEL R-1201A TEST AND ALIGNMENT PROCEDURE

This 29 step Test and Alignment Procedure is followed by a Test and Alignment Data Sheet which supports the procedure in programming the FREQUENCY-MHz Selector Switch recording of measurements and the check off of adjustments and verifications in a step-by-step sequence.

NOTE

Allow two hours warm up before performing this procedure. If the time base reference oscillator is to be calibrated (Step 2) 72 hour warm up is required.

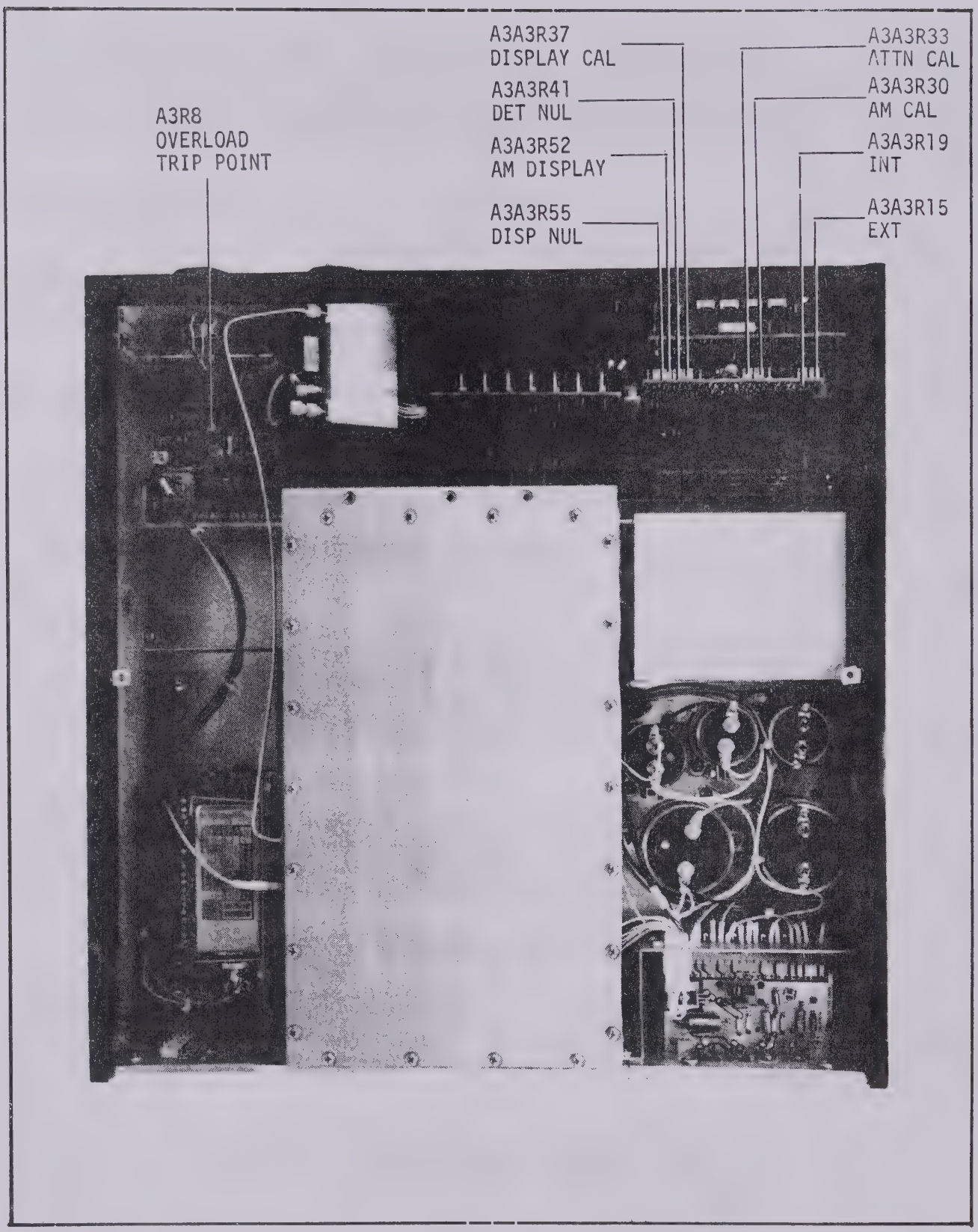


FIGURE 5-2A ADJUSTMENT LOCATION DIAGRAM TOP VIEW

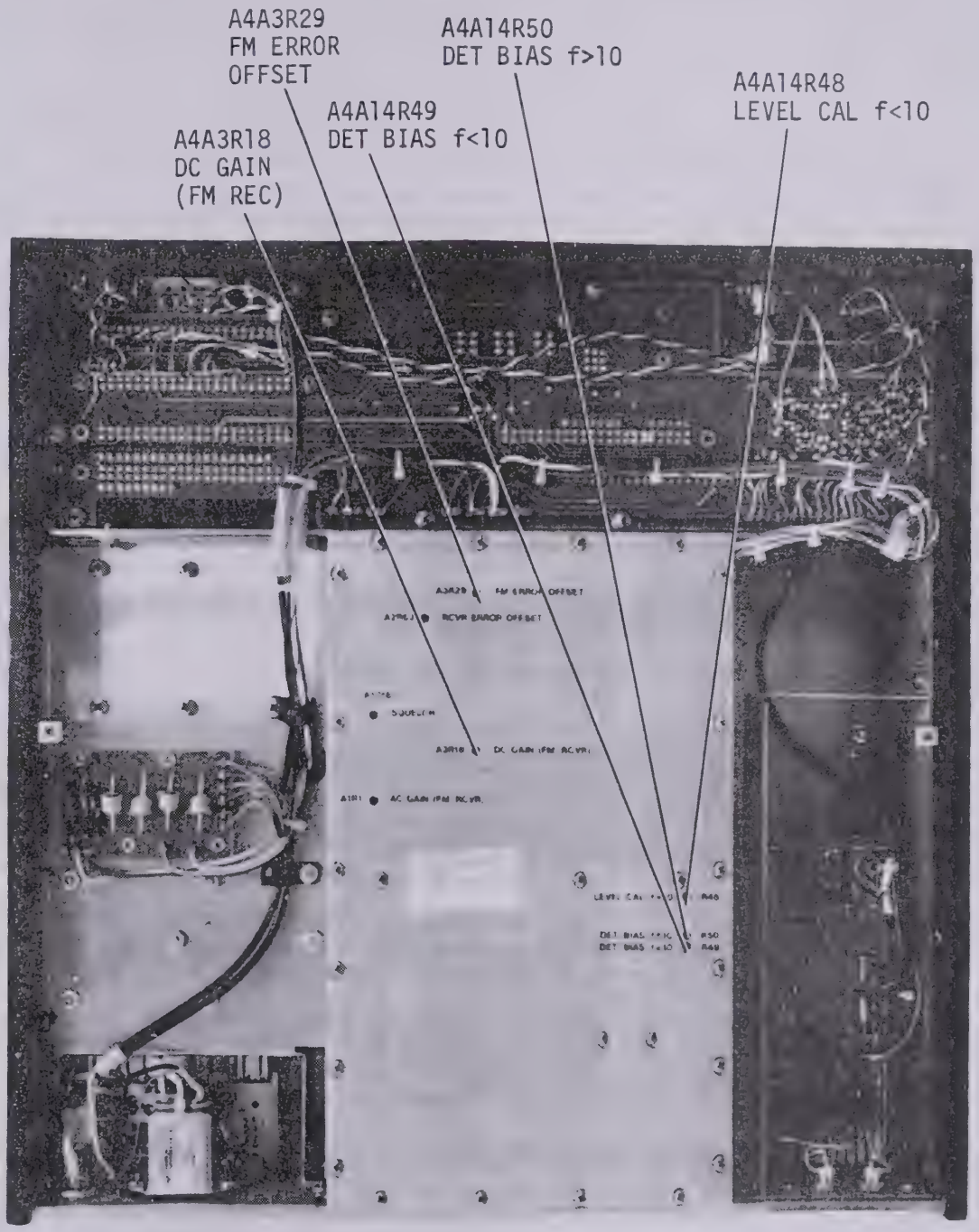


FIGURE 5-2B ADJUSTMENT LOCATION DIAGRAM BOTTOM VIEW

1. Connect a Frequency Counter to the Front Panel RF OUT "N" connector with a 50Ω coax terminator. Set the ATTENUATOR and OUTPUT LEVEL controls for a maximum output of 1.0 Vrms (+13 dBm). Depress the MODULATION MODE CW pushbutton switch. Verify that the counter readout is correct for each frequency setting on the FREQUENCY-MHz Selector Switch on the Test Data Sheet.

2. Calibrate the reference oscillator using the procedure in Section 5.3.

3. Program the FREQUENCY-MHz Selector Switch to 110.0000 MHz. Rotate the OUTPUT LEVEL control fully counter clockwise. Connect a Spectrum Analyzer to the RF OUT "N" connector. Adjust potentiometer A4A14R50 (DET BIAS f>10 R50) via its adjustment port of the bottom cover of the Synthesizer, to a point where the output 110 MHz signal just stops decreasing and the LEVEL LED indicator extinguishes.

4. Program the FREQUENCY-MHz Selector Switch to 010.0000 MHz. Rotate the OUTPUT LEVEL control to its 1.0V position. Place the Spectrum Analyzer in its linear mode, and adjust it to display and measure the level of the 10 MHz signal. Note and record the level on the Test Data Sheet.

5. Program the FREQUENCY-MHz Selector Switch to 009.9000 MHz. Adjust potentiometer A4A14R48 (LEVEL CAL f<10 R48) via its adjustment port on the bottom cover of the Synthesizer, to obtain an output level indicated on the Spectrum Analyzer that is exactly the same as was obtained in step 4.

6. Program the FREQUENCY-MHz Selector Switch to 010.0000 MHz. Rotate the OUTPUT LEVEL control to its 0.1V indication. Adjust the Spectrum Analyzer for a linear mode display of the 10 MHz signal. Note and record its level on the Test Data Sheet.

7. Program the FREQUENCY-MHz Selector Switch to 009.9000 MHz. Adjust potentiometer A4A14R49 (DET BIAS f<10 R49) to obtain an output level that is exactly the same as was obtained in step 6.

8. Connect a Power Meter to the RF OUT "N" connector. Set the ATTENUATOR control to its -20 dB position and the OUTPUT LEVEL control to its 1.0V setting. Program the FREQUENCY-MHz Selector Switch to 175.0000 MHz. Adjust potentiometer A3A3R33 (ATTN CAL) located on the Modulation Control PCB Assembly A3A3, for an indication of -7 dBm on the Power Meter.

9. Connect a Spectrum Analyzer via a switchable 20 dB attenuator pad to the RF OUTPUT "N" connector. Adjust the Spectrum Analyzer for a linear display with the 175 MHz signal one division down from the top of the display.

10. Switch out the 20 dB pad. Adjust the OUTPUT LEVEL control to produce the same Spectrum Analyzer display as in step 9. Loosen the set screw on the OUTPUT LEVEL control knob and adjust the position of the knob (without moving its shaft) so that the knob indicates 0.1V on its dial skirt, then tighten the set screw.

11. Repeat steps 8 through 10 to check and calibrate the 1.0V and 0.1V settings of the OUTPUT LEVEL control.

12. Connect a Power Meter to the RF OUT "N" connector. Set the ATTENUATOR to its .1V (-20 dB) position and the OUTPUT LEVEL control to 1V. Note the Power Meter reading for each FREQUENCY-MHz Selector Switch setting from 10.1 MHz to 250.1 MHz in 10 MHz increments. Record the frequencies of the maximum and minimum levels and their respective levels in dBm on the Test Data Sheet.

13. Note the Power Meter reading for each FREQUENCY-MHz Selector Switch setting from 250.1 MHz to 550.1 MHz in 10 MHz increments. Record the frequencies of the maximum and minimum levels and their respective levels in dBm on the Test Data Sheet.

14. Note the Power Meter reading for each FREQUENCY-MHz Selector Switch setting from 550.1 MHz to 999.1 MHz in 10 MHz increments. Record the frequencies of the maximum and minimum levles and their respective levels in dBm on the Test Data Sheet.

15. Rotate the OUTPUT LEVEL control to its 1.0V (+13 dBm) setting. Measure the output level for each ATTENUATOR step position for each of the frequencies recorded in steps 12 through 14, and enter on the Test Data Sheet. Note: This measurement requires a relatively complex measuring system to achieve required accuracy.

16. Connect a Frequency Counter to the RF OUT "N" connector. Select the CW MODULATION MODE and the EXT MODULATION SOURCE, and note the reading on the Frequency Counter. Select the FM MODULATION MODE with no input applied to the EXT MOD BNC connector and adjust A4A3R29 (FM ERROR OFFSET) potentiometer for the same reading on the Frequency Counter that was noted when the CW MODULATION MODE was selected. Apply -5.2V through a 390Ω resistor to the Front Panel EXT MOD BNC connector. Monitor the error out signal at A4XA17 pin E with a DVM and adjust the Front Panel MODULATION EXTERNAL control for a DVM indication of -2.00 Vdc. Adjust potentiometer A4A3R18 (DC GAIN FM REC) for a 20 kHz increase on the Frequency Counter. Recheck the A4A3R29 (FM ERROR OFFSET) adjustment.

17. With an Oscilloscope monitor Test Point A3A3TP2 and adjust potentiometer A3A3R41 (DET NULL) for a maximum noise indication on the Oscilloscope. Then adjust potentiometer A3A3R55 (DISP NULL) for a 00.00 indication on the Front Panel 3-1/2 digit display.

18. With EXT MOD SOURCE and FM MODULATION MODE selected, apply 4160 Hz to the EXT MOD input using the SLN-6381A Audio Frequency Synthesizer as the audio frequency source, connect the Spectrum Analyzer to the RF OUT "N" connector. Adjust the Analyzer for 2 kHz/cm display. Slowly increase the EXT MOD control from minimum watching for the first carrier null on the Analyzer. Then adjust A3A3R37 (DISPLAY CAL) for a 10.00 kHz indication on the Front Panel display. Then repeat step 18.

19. With the EXT MOD SOURCE and FM MODULATION selected, set the Audio Synthesizer to 2080 Hz. Slowly increase the EXT MOD control from minimum, watching for the first carrier null on the Analyzer. Then adjust A3A3R41 (DET NULL) for a 05.00 kHz indication on the Front Panel 3-1/2 digit display.

20. Recheck the 3-1/2 digit display for the following first null audio Frequencies.

1st Null 2080 Hz 04.75 to 5.25 kHz.
1st Null 4160 Hz 09.60 to 10.40 kHz.
1st Null 8020 Hz 17.36 to 18.64 kHz.

Readjust A3A3R37 and A3A3R41 if necessary to bring the 3-1/2 digit display into the above tolerances.

21. With EXT MOD SOURCE and FM MODULATION MODE selected apply a 1 kHz 4V peak-to peak signal from a SD-405 Function Generator to the EXT MOD Input. Rotate the EXT MOD control fully clockwise. Then adjust potentiometer A3A3R15 (EXT) to a point that will cause the 3-1/2 digit display to flash. Select INT MOD SOURCE, rotate INT MOD control fully clockwise, then adjust potentiometer A3A3R19 (INT) to a point that will cause the 3-1/2 digit display to flash.

22. Select AM MODULATION MODE and EXT MOD SOURCE. Lower the level of the applied 1 kHz signal from the Function Generator to 2V peak-to-peak, then adjust potentiometer A3A3R52 (AM DISPLAY) for a 50% indication on the 3-1/2 digit display.

23. With the 1 kHz 2V peak-to-peak signal applied, set the OUTPUT LEVEL control to its .5V (+7 dBm) position and the step ATTENUATOR switch to its .1V (-20 dB) position, adjust potentiometer A3A3R30 (AM CAL) for 50% modulation at the RF OUT "N" connector as observed on an Oscilloscope properly terminated at 50Ω.

24. Select the EXT MODULATION SOURCE. Rotate the EXTERNAL MODULATION control to its mid-range setting. Connect the SLN-6381A Audio Synthesizer to the EXT MOD BNC connector. Verify that the Amplitude modulation is produced at 1 Hz to 10 kHz audio modulation frequencies.

25. Select the CW MODULATION MODE. Set the OUTPUT LEVEL control to its 1.0V (+13 dBm) position and the step ATTENUATOR to its .1V (-20 dBm) step. Connect a Spectrum Analyzer to the RF OUT "N" connector. Set up the Spectrum Analyzer for log mode, and for each frequency shown on the Test Data Sheet, verify that all harmonics are -25 dBc.

NOTE

Ensure that the Spectrum Analyzer controls are adjusted to prevent overloading of its input circuits, and causing self generation of harmonics.

26. Verify that nonharmonic spurious responses are within specification for the frequencies shown on the Data Sheet.

27. For each frequency listed on the Test Data Sheet perform the noise measurements by setting up the Spectrum Analyzer as follows:

Dispersion	20 kHz/DIV
Bandwidth	1 kHz
Video Filter	100 Hz

Adjust the Spectrum Analyzer so that the amplitude of the output signal is displayed at the reference (top) graticule line. Record the amplitude of the Spectrum Analyzer display at a frequency that is offset 50 kHz from the output frequency. Subtract 36 dB from the recorded measurement to provide the 1 Hz BW noise figure.

28. Connect an adjustable 0 to 20 Vdc Power Supply to the RF OUT "N" connector. Set the step ATTENUATOR control to its 1 μV (-120 dB) setting and the OUTPUT LEVEL control to its .5V (+7 dBm) position. Slowly increase the Power Supply voltage until the OVERLOAD indicator illuminates and the LEVEL indicator extinguishes, thus indicating that the output protector circuit has tripped. Note and record the trip point voltage on the Test Data Sheet. Reduce the Power Supply voltage to 5V, depress the OVERLOAD RESET pushbutton switch and verify that the OVERLOAD indicator extinguishes and the LEVEL Indicator illuminates. Repeat the above test with the Power Supply polarity reversed. Both the + and - trip points should be between 5 to 17 volts in magnitude.

29. Connect a Signal Generator to the input of an RF Power Amplifier. Adjust the Signal Generator to generate a 100 MHz minimum output level signal. Connect the Power Amplifier to the RF OUT "N" connector. Slowly increase the level of the applied 100 MHz signal until the OVERLOAD indicator illuminates and the LEVEL indicator extinguishes, indicating that the output protector circuit has tripped. Without changing the level setting of the applied signal, disconnect the Power Amplifier's output from the RF OUT connector and connect it to an Oscilloscope via a 20 dB 50Ω attenuator pad. The Oscilloscope indication should be between 0.8V and 3.5V peak-to-peak. If not, adjust potentiometer A3R8 (OVERLOAD TRIP POINT) to bring the trip point within 0.8V and 3.5V peak-to-peak.

MODEL R-1201A SIGNAL GENERATOR TEST AND ALIGNMENT DATA SHEET

Serial Number

Date

1.

FREQUENCY SETTING (MHz)	COUNTER READING AGREES (√)
010.0000	
101.1111	
222.2222	
444.4444	
888.8888	

2. Reference Oscillator adjusted per paragraph 5.3 procedure _____ (√)

3. A4A14R50 (DET BIAS≥f 10 ⊘ R50) adjust for minimum output point at 110 MHz. _____ (√)

4. Level at 10 MHz 1.0V _____ (dBm)

5. A4A14R48 (LEVEL CAL<f 10 ⊘ R48) adjusted for level recorded in step 4 at 9.9 MHz. _____ (√)

6. Level at 10 MHz 0.1V. _____ (dBm)

7. A4A14R49 (DET BIAS<f 10 ⊘ R49) adjusted for level recorded in step 6 at 9.9 MHz. _____ (√)

8. A3A3R18 (ATTN CAL) and OUTPUT LEVEL control knob position set to calibrate OUTPUT LEVEL control at 0.1V and 1.0V settings. _____ (√)

11. Repeat steps 8 through 10. _____ (√)

12. Power Meter readings between 10 and 250 MHz.

Maximum output F_1 = _____ MHz

Minimum output F_2 = _____ MHz

Power @F_3 _____ dBm(≤-6)

Power @F_4 _____ dBm(≥-8)

13. Power Meter readings between 250 and 550 MHz

Maximum output F_3 = _____ MHz

Minimum output F_4 = _____ MHz

Power @F_3 _____ dBm(≤-5.5)

Power @F_4 _____ dBm(≥-8.5)

14. Power Meter readings between 550 and 999 MHz

Maximum output F_5 = _____ MHz

Minimum output F_6 = _____ MHz

Power @F_5 _____ dBm(≤-5)

Power @F_6 _____ dBm(≥-9)

15. Output Level at 1.0V (+13 dBm)

10-250 MHz

ATTENUATOR SETTING (dB)	@F_1 = ____ MHz LEVEL (dB)	@F_2 = ____ MHz LEVEL (dB)
-20	_____ (±1)	_____ (±1)
-40	_____ (±2)	_____ (±2)
-60	_____ (±2)	_____ (±2)
-80	_____ (±2)	_____ (±2)
-100	_____ (±2.5)	_____ (±2.5)
-120	_____ (±2.5)	_____ (±2.5)

250-500 MHz

ATTENUATOR SETTING (dB)	@F_3 = ____ MHz LEVEL (dB)	@F_4 = ____ MHz LEVEL (dB)
-20	_____ (±1.5)	_____ (±1.5)
-40	_____ (±2.5)	_____ (±2.5)
-60	_____ (±2.5)	_____ (±2.5)
-80	_____ (±2.5)	_____ (±2.5)
-100	_____ (±3)	_____ (±3)
-120	_____ (±3)	_____ (±3)

550-999 MHz

ATTENUATOR SETTING (dB)	@F_5 = ____ MHz LEVEL (dB)	@F_6 = ____ MHz LEVEL (dB)
-20	_____ (±2)	_____ (±2)
-40	_____ (±3.5)	_____ (±3.5)
-60	_____ (±3.5)	_____ (±3.5)
-80	_____ (±3.5)	_____ (±3.5)
-100	_____ (±4)	_____ (±4)
-120	_____ (±4)	_____ (±4)

16. Frequency CW Mode _____MHz

A4A3R29 (FM ERROR OFFSET) adjusted for same frequency as CW Mode reading. _____(√)

17. A3A3R41 (DET NULL) adjusted for maximum noise at Test Point A3A3TP2. _____(√)

A3A3R55 (DISP NULL) adjusted for a 00.00 3-1/2 digit display indications. _____(√)

18. A3A3R37 (DISPLAY CAL) adjusted for 10.00 kHz on the 3-1/2 digit display at a 416 Hz carrier null. _____(√)

19. A3A3R41 (DET NULL) adjusted for a 05.00 Hz on the 3-1/2 digit display at a 2080 Hz carrier null. _____(√)

20. 3-1/2 digit display indication is within tolerance for first null 2080 Hz, 4160 Hz and 8020 Hz audio modulation inputs. _____(√)

21. A3A3R15 (EXT) and A3A3R19 (INT) adjusted to allow the 3-1/2 digit display to flash on a 1 kHz 4V peak-to-peak external modulation input. _____(√)

22. A3A3R52 (AM DISPLAY) adjusted for a 50% 3-1/2 digit display indication on a 1 kHz 2V peak-to-peak external modulation input. _____(√)

23. A3A3R30 (AM CAL) adjusted for a 50% modulation output at the RF OUT connector. _____(√)

24. External AM capability

10 Hz _____(√)

100 Hz _____(√)

1 kHz _____(√)

10 kHz _____(√)

20 kHz _____(√)

25. CW 0.1V (-20 dBm)

FREQUENCY SETTING (MHz)	HARMONIC LEVEL (dBc)
27.9	_____(≤-25)
83.2	_____(≤-25)
108.7	_____(≤-25)
156.8	_____(≤-25)
253.6	_____(≤-25)
442.1	_____(≤-25)
607.9	_____(≤-25)
898.2	_____(≤-25)

26. CW 0.1V (-20 dBm)

FREQUENCY SETTING (MHz)	SPURIOUS RESPONSES (dBc)
27.9	_____(≤-40)
83.2	_____(≤-40)
108.7	_____(≤-40)
156.8	_____(≤-50)
253.6	_____(≤-50)
442.1	_____(≤-50)
607.9	_____(≤-50)
898.2	_____(≤-50)

27.

FREQUENCY SETTING (MHz)	NOISE READING (dBc)	-36 dB = 1 Hz BW (dBc)
153.6	_____	_____(≤-103)
458.2	_____	_____(≤-103)
876.3	_____	_____(≤ -97)

28. Output protector circuit dc trip points — Positive _____Vdc(5-17)
Negative _____Vdc(5-17)

29. Output Protector circuit RF trip point — _____ Vp-p(.8-3.5)

5.6 INTEGRATED CIRCUITS COMPONENT DATA

The following integrated circuit data sheets are provided to give the service technican pinning information, schematic equivalents and detailed characteristics that are unique to the IC device. Table 5-2 lists the IC's in alphanumeric manufacturers part number order.

TABLE 5-2 INTEGRATED CIRCUIT DATA SHEETS

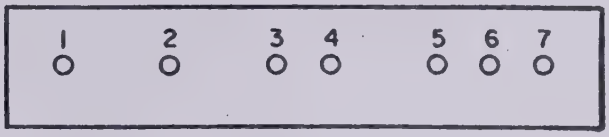
COMPONENT NUMBER	TITLE	S-D PART NUMBER	PAGE
ATF-417	1 GHz RF Amplifier	103012	5-15
CA3026	Dual Differential Amplifier	025724	5-16
CA3076	Dual Differential Amplifier	025770	5-17
CA3089E	Wideband IF Amplifier/Limiter	045261	5-18
CA3130T	Linear Operational Amplifier	103231	5-19
CD4099	CMOS 8-Bit Data Selector/Latch	117116	5-22
LF355	Operational Amplifier	103701	5-23
LM201A	Operational Amplifier	037913	5-24
LM301A	Operational Amplifier	025745	5-24
LM324	Operational Amplifier	103196	5-25
LM741	Operational Amplifier	103708	5-26
MC1590G	Wideband Amplifier with AGC	025788	5-27
MC3002P	TTL Quad 2-Input OR Gate	025739	5-28
MC3021	TTL Quad Exclusive OR Gate	025789	5-28
MC4016	Programmable Modulo-N Counters	045237	5-29
MC4044	Phase-Frequency Detector	045238	5-32
MC7805CP	+5V Voltage Regulator	045256	5-33
MC7815CP	+15V Voltage Regulator	103039	5-33
MC7824CP	+24V Voltage Regulator	045246	5-33
MC7905.2CP	-5.2V Voltage Regulator	103033	5-34
MC7915CP	-15V Voltage Regulator	103040	5-34
MC10102	ECL Quad 2-Input NOR Gate	103025	5-35
MC10106	ECL Triple 4-3-3 Input NOR Gate	103168	5-36
MC10115	ECL Quad Line Receiver	045254	5-37
MC10125	ECL Quad ECL-to-TTL Translator	106660	5-38
MC10131	ECL Dual D Master-Slave Flip/Flop	045239	5-39
MC10137	ECL Decade Counter	103027	5-40
MC12014L	TTL Counter Control Logic	045263	5-41
MC12040	ECL Phase-Frequency Detector	045277	5-42
MC14001	CMOS Quad 2-Input NOR Gate	045283	5-43
MC14013	CMOS Dual D Flip/Flop	103199	5-44
MC14016	CMOS Quad Analog Switch/Multiplexer	103323	5-45
MC14028	CMOS BCD-To-Decimal Decoder	045286	5-46
MC14050	CMOS Hex Inverter Buffer	103492	5-47
MC14071	CMOS Quad 2-Input OR Gate	103940	5-48
MC14433	CMOS 3-1/2 Digit A/D Converter	117326	5-49
MC14518CP	CMOS Dual BCD Up Counter	103339	5-53
MC14528	CMOS Dual Monostable Multivibrator	045289	5-55
MC14560	CMOS NBCD Adder	103433	5-56
SAM-1	600 MHz Mixer	102911	5-57
SAM-2	1 GHz Mixer	102815	5-58

TABLE 5-2 INTEGRATED CIRCUIT DATA SHEETS (Cont'd)

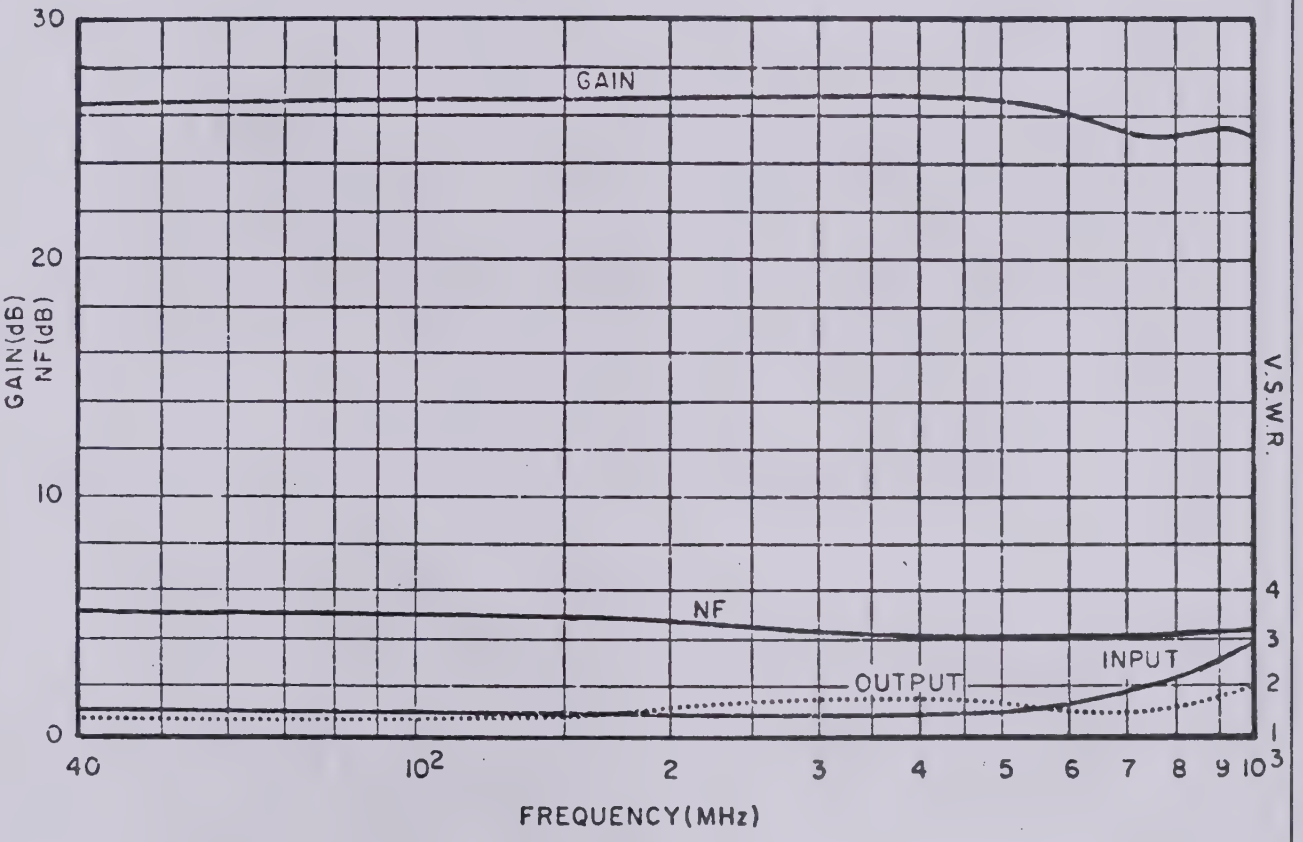
COMPONENT NUMBER	TITLE	S-D PART NUMBER	PAGE
SN7400N	TTL Low Power Schottky Quad 2-Input NAND Gate	019705	5-59
SN74L04	Hex Inverter	045204	5-60
SN7408N	TTL Low Power Schottky Quad 2-Input AND Gate	103093	5-61
SN7432N	TTL Quad 2-Input OR Gate	045257	5-62
SN7442N	TTL BCD-To-Decimal Decoder	025749	5-63
SN74L75	TTL Low Power 4-Bit Bistable Latch	045201	5-64
11C90	ECL Divide-By-10/11 Counter	103416	5-65

1 GHz RF AMPLIFIER

ATF-417 S-D P/N 103012



PIN NO. 1	– INPUT
PIN NO. 2,3,5,6	– GROUND
PIN NO 4	– +24V
PIN NO. 7	– OUTPUT



DUAL DIFFERENTIAL AMPLIFIER

CA3026
CA3054

S-D P/N 025724

12-Lead TO-5

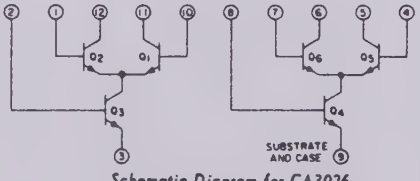
14-Lead
Dual-In-Line
Plastic Package

The CA3026 and CA3054 each consists of two independent differential amplifiers with associated constant-current transistors on a common monolithic substrate. The six n-p-n transistors which comprise the amplifiers are general purpose devices which exhibit low 1/f noise and a value of f_T in excess of 300 MHz. These features make the CA3026 and CA3054 useful from dc to 120 MHz. Bias and load resistors have been omitted to provide maximum application flexibility.

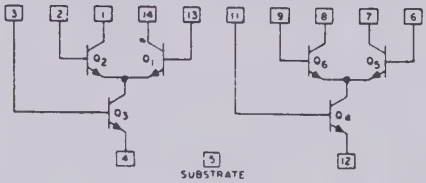
The monolithic construction of the CA3026 and CA3054 provides close electrical and thermal matching of the amplifiers. This feature makes these devices particularly useful in dual channel applications where matched performance of the two channels is required.

The CA3026 is supplied in a hermetic 12-lead TO-5 style package and is rated for full military operating-temperature range of -55°C to +125°C.

The CA3054 is supplied in a 14-lead plastic Dual-in-line package with a limited temperature range. The availability of extra terminals allows the introduction of an independent substrate connection for maximum flexibility.

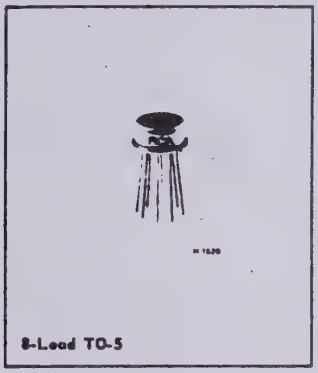


Schematic Diagram for CA3026.



Schematic Diagram for CA3054.

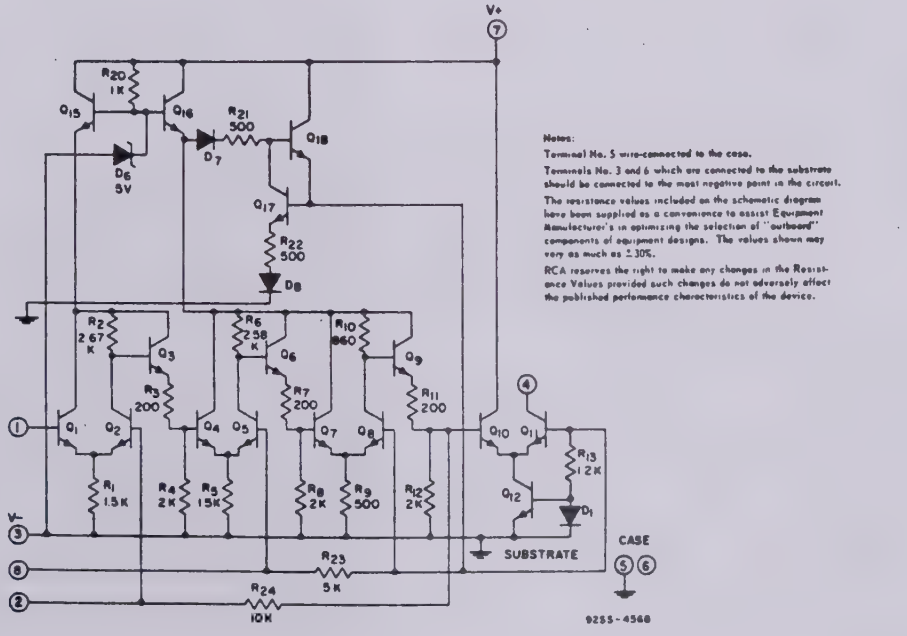
CA3076 S-D P/N 025770



RCA CA3076, monolithic integrated circuit, is a high-gain wide-band amplifier-limiter for use in the IF sections of Communications and High-Fidelity FM Receivers. The CA3076, shown in the schematic diagram (Fig. 2), consists of a four stage IF amplifier-limiter section with a voltage regulator section. A typical application of the CA3076 in FM receiver circuits is shown in the block diagram (Fig. 1).

The four-stage emitter-follower-coupled IF amplifier section provides an 80-dB voltage gain with a 2-kilohm load at a frequency of 10.7 MHz. The output stage has exceptionally good limiting characteristics because of its transistor constant-current sink. The voltage regulator section provides zener-regulated, decoupled voltages for the IF amplifier.

The CA3076 utilizes an hermetically-sealed 8-lead TO-5 package.



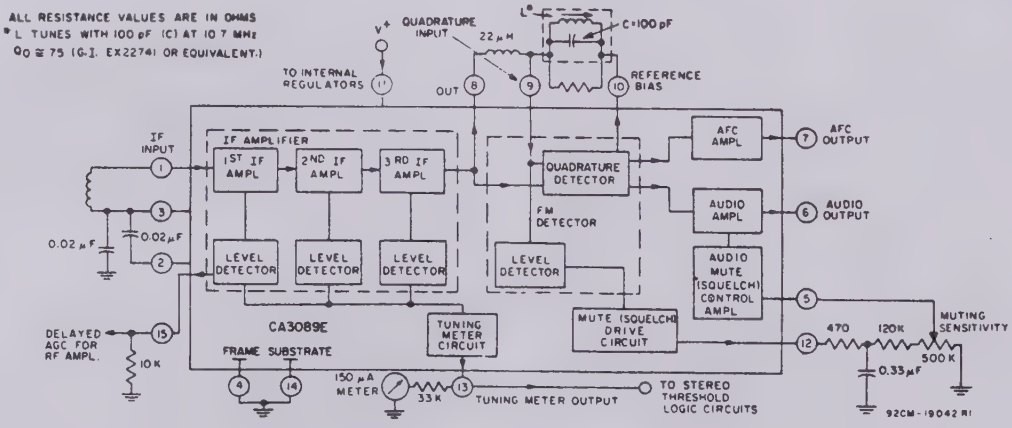
Schematic diagram of CA3076.

16-Lead Dual-in-Line
Plastic Package

H-1622

RCA-CA3089E* is a monolithic integrated circuit that provides all the functions of a comprehensive FM-IF system. Fig. 1 is a block diagram showing the CA3089E features, which include a three-stage FM-IF amplifier/limiter configuration with level detectors for each stage, a doubly-balanced quadrature FM detector and an audio amplifier that features the optional use of a muting (squelch) circuit.

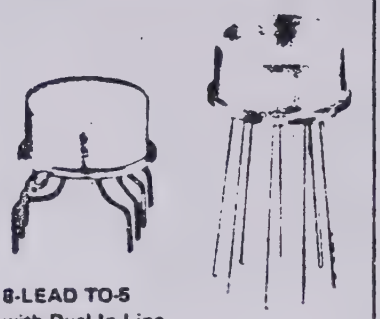
The advanced circuit design of the IF system includes desirable deluxe features such as delayed AGC for the RF tuner, an AFC drive circuit, and an output signal to drive a tuning meter and/or provide stereo switching logic. In addition, internal power supply regulators maintain a nearly constant current drain over the voltage supply range of +8.5 to +16 volts.



Block diagram of the CA3089E.

CA3130T

S-D P/N 103231



8-LEAD TO-5 with Dual-In-Line Formed Leads (S suffix) H-1787

8-LEAD TO-5 (T suffix) H-1528

COS/MOS Operational Amplifiers

With MOS/FET Input

Features:

- MOS/FET input stage provides:
  - very high Z_I = 1.5 TΩ (1.5 x 10^{12} Ω) typ.
  - very low I_I = 5 pA typ. at 15 V operation
  - 2 pA typ. at 5 V operation
- Common-mode input-voltage range includes negative supply rail; input terminals can be swung 0.5 V below negative supply rail
- COS/MOS output stage permits signal swing to either (or both) supply rails

} Ideal for single-supply applications

- Low V_{IO}: 2 mV max. (CA3130B)
- Wide BW: 15 MHz typ. (unity-gain crossover)
- High SR: 10 V/μs typ. (unity-gain follower)
- High output current (I_O): 20 mA typ.
- High A_{OL}: 320,000 (110 dB) typ.
- Compensation with single external capacitor

Applications:

- Ground-referenced single-supply amplifiers
- Fast sample-hold amplifiers
- Long-duration timers/monostables
- High-input-impedance comparators (ideal interface with digital COS/MOS)
- High-input-impedance wideband amplifiers
- Voltage followers (e.g., follower for single-supply D/A converter)
- Voltage regulators (permits control of output voltage down to zero volts)
- Peak detectors
- Single-supply full-wave precision rectifiers
- Photo-diode sensor amplifiers

RCA-CA3130T, CA3130S, CA3130AT, CA3130AS, CA-3130BT, and CA3130BS are integrated-circuit operational amplifiers that combine the advantages of both COS/MOS and bipolar transistors on a monolithic chip.

Gate-protected p-channel MOS/FET (PMOS) transistors are used in the input circuit to provide very-high-input impedance, very-low-input current, and exceptional speed performance. The use of PMOS field-effect transistors in the input stage results in common-mode input-voltage capability down to 0.5 volt below the negative-supply terminal, an important attribute in single-supply applications.

A complementary-symmetry MOS (COS/MOS) transistor pair, capable of swinging the output voltage to within millivolts of either supply-voltage terminal (at very high values of load impedance), is employed as the output circuit.

The CA3130 Series circuits operate at supply voltages ranging from 5 to 16 volts, or ±2.5 to ±8 volts when using split supplies. They can be phase compensated with a single external capacitor, and have terminals for adjustment of offset voltage for applications requiring offset-null capability. Terminal provisions are also made to permit strobing of the output stage.

The CA3130 Series is supplied in either the standard 8-lead TO-5-style package (T suffix) or in the 8-lead dual-in-line formed-lead TO-5-style package "DIL-CAN" (S suffix) and operates over the full military-temperature range of −55°C to +125°C. The CA3130B is intended for applications requiring premium-grade specifications and with limits established for: input current, temperature coefficient of input-offset voltage, and gain over the range of −55°C to +125°C. The CA3130A offers superior input characteristics over those of the CA3130.

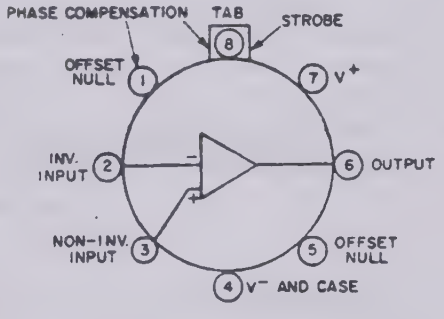
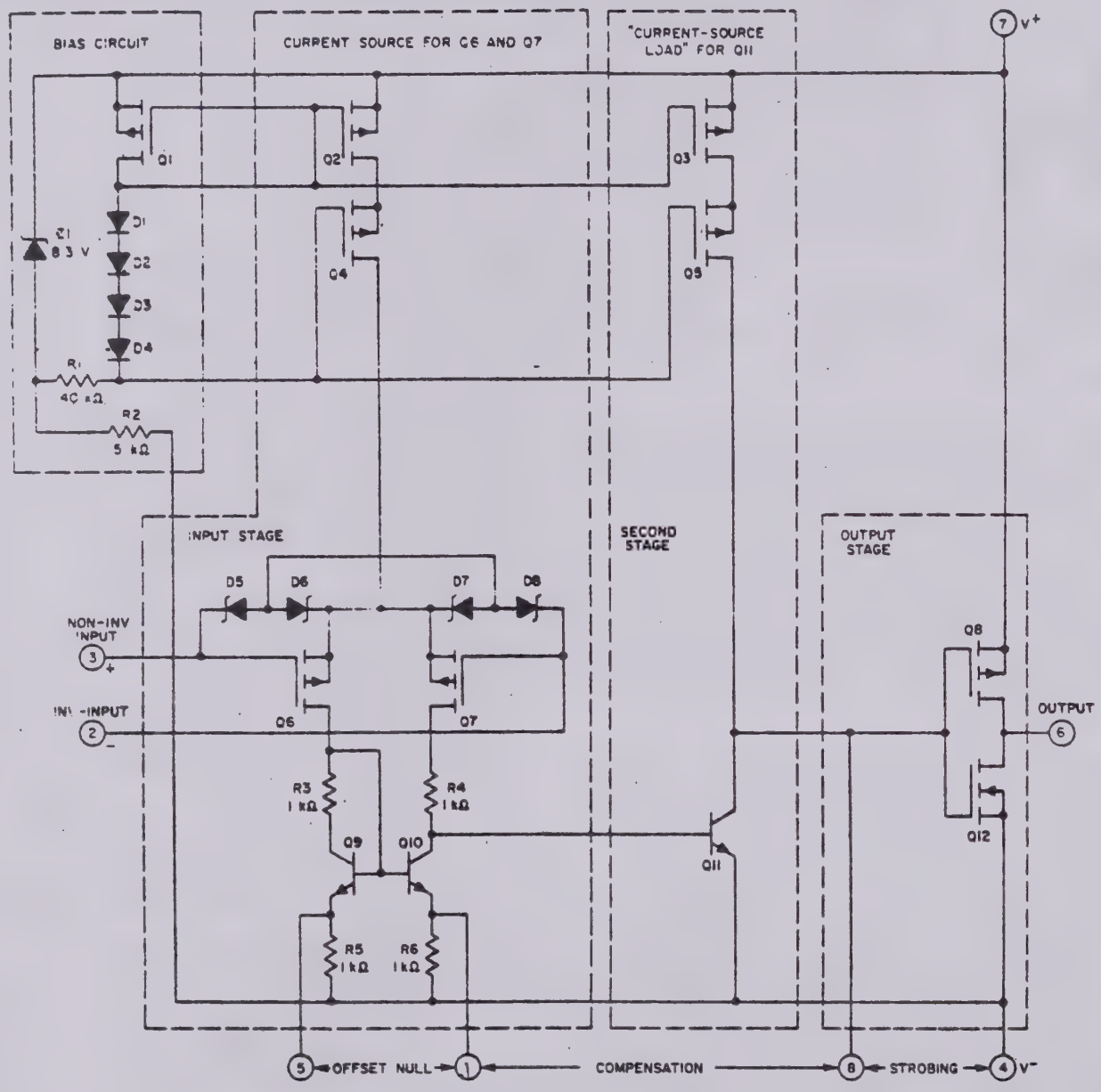


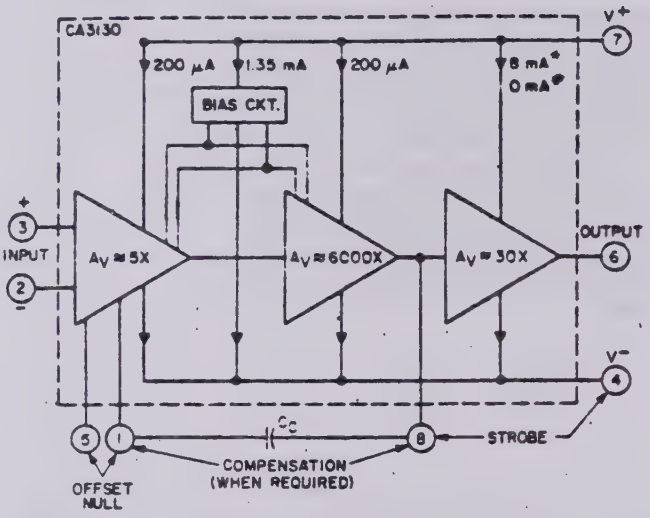
Fig. 1—Functional diagram of the CA3130 Series.



NOTE:
DIODES D5 THROUGH D8 PROVIDE GATE-OXIDE PROTECTION FOR MOS/FET INPUT STAGE.

Fig. 2—Schematic diagram of the CA3130 Series.

CA3130T **S-D P/N 103231**



TOTAL SUPPLY VOLTAGE (FOR INDICATED VOLTAGE GAINS) = 15 V
* WITH INPUT TERMINALS BIASED SO THAT TERM. 6 POTENTIAL IS +7.5 V ABOVE TERM. 4.
* WITH OUTPUT TERMINAL DRIVEN TO EITHER SUPPLY RAIL.

92CS-24715

Fig. 3—Block diagram of the CA3130 Series.

transistors Q2, Q4 are the constant-current source for the input stage. The biasing circuit for the constant-current source is subsequently described. The small diodes D5 through D8 provide gate-oxide protection against high-voltage transients, e.g. including static electricity during handling for Q6 and Q7.

Second Stage—Most of the voltage gain in the CA3130 is provided by the second amplifier stage, consisting of bipolar transistor Q11 and its cascode-connected load resistance provided by PMOS transistors Q3 and Q5. The source of bias potentials for these PMOS transistors is subsequently described. Miller-Effect compensation (roll-off) is accomplished by simply connecting a small capacitor between Terms. 1 and 8. A 47-picofarad capacitor provides sufficient compensation for stable unity-gain operation in most applications.

Bias-Source Circuit—At total supply voltages, somewhat above 8.3 volts, resistor R2 and zener diode Z1 serve to establish a voltage of 8.3 volts across the series-connected circuit, consisting of resistor R1, diodes D1 through D4, and PMOS transistor Q1. A tap at the junction of resistor R1 and diode D4 provides a gate-bias potential of about 4.5 volts for PMOS transistors Q4 and Q5 with respect to Term. 7. A potential of about 2.2 volts is developed across diode-connected PMOS transistor Q1 with respect to Term. 7 to provide gate bias for PMOS transistors Q2 and Q3. It should be noted that Q1 is "mirror-connected"† to both Q2 and Q3. Since transistors Q1, Q2, Q3 are designed to be identical, the approximately 200-microampere current in Q1 establishes a similar current in Q2 and Q3 as constant-current sources for both the first and second amplifier stages, respectively.

At total supply voltages somewhat less than 8.3 volts, zener diode Z1 becomes non-conductive and the potential, developed across series-connected R1, D1-D4, and Q1, varies directly with variations in supply voltage. Consequently, the gate bias for Q4, Q5 and Q2, Q3 varies in accordance with supply-voltage variations. This variation results in deterioration of the power-supply-rejection ratio (PSRR) at total supply voltages below 8.3 volts. Operation at total supply voltages below about 4.5 volts results in seriously degraded performance.

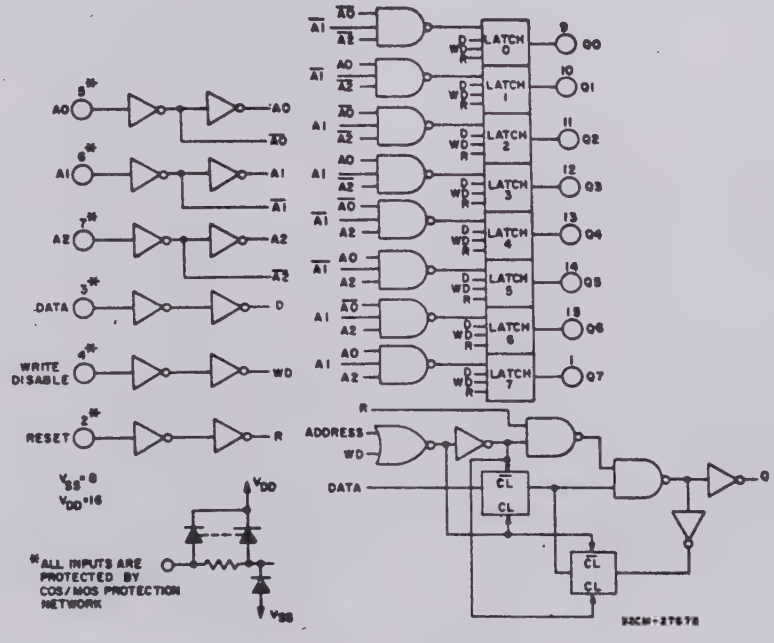
Output Stage—The output stage consists of a drain-loaded inverting amplifier using COS/MOS transistors operating in the Class A mode. When operating into very high resistance loads, the output can be swung within millivolts of either supply rail. Because the output stage is a drain-loaded amplifier, its gain is dependent upon the load impedance. The transfer characteristics of the output stage for a load returned to the negative supply rail are shown in Fig. 6. Typical op-amp loads are readily driven by the output stage. Because large-signal excursions are non-linear, requiring feedback for good waveform reproduction, transient delays may be encountered. As a voltage follower, the amplifier can achieve 0.01 per cent accuracy levels, including the negative supply rail.

The RCA-CD4099B 8-bit addressable latch is a serial-input, parallel-output storage register that can perform a variety of functions.

Data are inputted to a particular bit in the latch when that bit is addressed (by means of inputs A0, A1, A2) and when WRITE DISABLE is at a low level. When WRITE DISABLE is high, data entry is inhibited; however, all 8 outputs can be continuously read independent of WRITE DISABLE and address inputs.

A master RESET input is available, which resets all bits to a logic "0" level when RESET and WRITE DISABLE are at a high level. When RESET is at a high level, and WRITE DISABLE is at a low level, the latch acts as a 1-of-8 demultiplexer; the bit that is addressed has an active output which follows the data input, while all unaddressed bits are held to a logic "0" level.

The CD4099B types are supplied in 16-lead hermetic ceramic dual-in-line packages (D, F, Y suffixes), 16-lead plastic dual-in-line packages (E suffix), 16-lead ceramic flat packages (K suffix), and in chip form (H suffix).



Logic diagram and schematic of 1 of 8 latches.

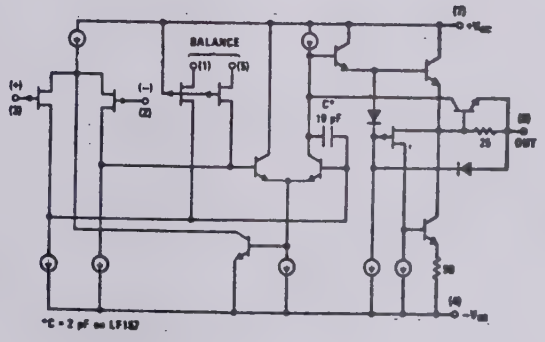
LF355
LF356

S-D P/N 103701
S-D P/N 117093

GENERAL DESCRIPTION

These are the first monolithic JFET input operational amplifiers to incorporate well matched, high voltage JFETs on the same chip with standard bipolar transistors (BI-FET Technology). These amplifiers feature low input bias and offset currents, low offset voltage and offset voltage drift, coupled with offset adjust which does not degrade drift or common-mode rejection. The devices are also designed for high slew rate, wide bandwidth, extremely fast settling time, low voltage and current noise and a low 1/f noise corner.

SIMPLIFIED SCHEMATIC



LM201A
LM301A

S-D P/N 037913
S-D P/N 025745

general description

The LM101 series are general purpose operational amplifiers which feature improved performance over industry standards like the LM709. Advanced processing techniques make possible an order of magnitude reduction in input currents, and a redesign of the biasing circuitry reduces the temperature drift of input current. Improved specifications include:

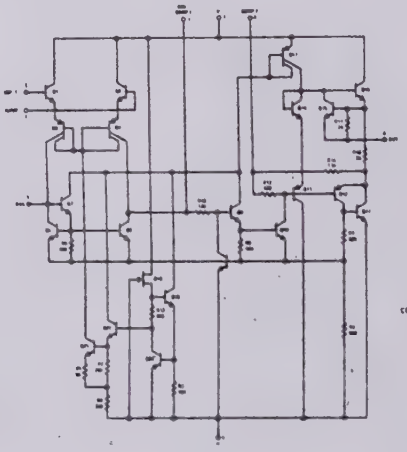
- Offset voltage 3 mV maximum over temperature (LM101A/LM201A)
- Input current 100 nA maximum over temperature (LM101A/LM201A)
- Offset current 20 nA maximum over temperature (LM101A/LM201A)
- Guaranteed drift characteristics
- Offsets guaranteed over entire common mode and supply voltage ranges
- Slew rate of 10V/μs as a summing amplifier

This amplifier offers many features which make its application nearly foolproof: overload protection on the input and output, no latch-up when the common mode range is exceeded, freedom from oscillations and compensation with a single 30 pF capacitor. It has advantages over internally compensated amplifiers in that the frequency compensation can be tailored to the particular application. For example, in low frequency circuits it can be overcompensated for increased stability margin. Or the compensation can be optimized to give more than a factor of ten improvement in high frequency performance for most applications.

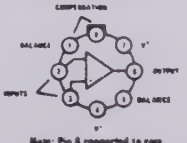
The LM101A series offers the features of the LM101, which makes its application nearly foolproof. In addition, the device provides better accuracy and lower noise in high impedance circuitry. The low input currents also make it particularly well suited for long interval integrators or timers, sample and hold circuits and low frequency waveform generators. Further, replacing circuits where matched transistor pairs buffer the inputs of conventional IC op amps, it can give lower offset voltage and drift at a lower cost.

The LM101/LM101A is guaranteed over a temperature range of −55°C to +125°C, the LM201A from −25°C to +85°C, and the LM201/LM301A from 0°C to +70°C.

schematic** and connection diagrams Top Views



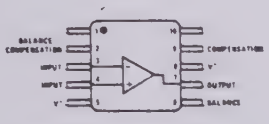
Metal Can Package



Note: Pin 4 connected to case.

Order Number LM101H, LM201H, LM101AH, LM201AH or LM301AH
See Package 11

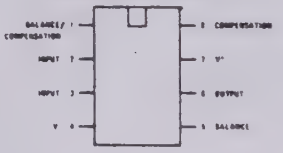
Flat Package



Note: Pin 5 connected to bottom of package

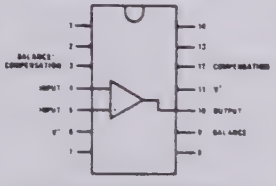
Order Number LM101F, LM201F, LM101AF or LM201AF
See Package 3

Dual-In-Line Package



Order Number LM201J or LM301AJ
See Package 15
Order Number LM301AN
See Package 20

Dual-In-Line Package



Note: Pin 8 connected to bottom of package

Order Number LM101AD or LM201AD
See Package 28
Order Number LM101AJ-14, LM201AJ-14, LM301AJ, LM101J-14 or LM201J-14
See Package 16

**Pin connections shown are for metal can.

LM324 S-D P/N 103196

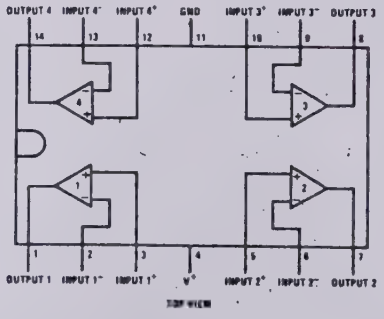
general description

The LM124 series consists of four independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

Application areas include transducer amplifiers, dc gain blocks and all the conventional op amp circuits which now can be more easily implemented in single power supply systems. For example, the LM124 series can be directly operated off of the standard +5 V_{DC} power supply voltage which is used in digital systems and will easily provide the required interface electronics without requiring the additional ±15 V_{DC} power supplies.

connection diagram

Dual-In-Line and Flat Package



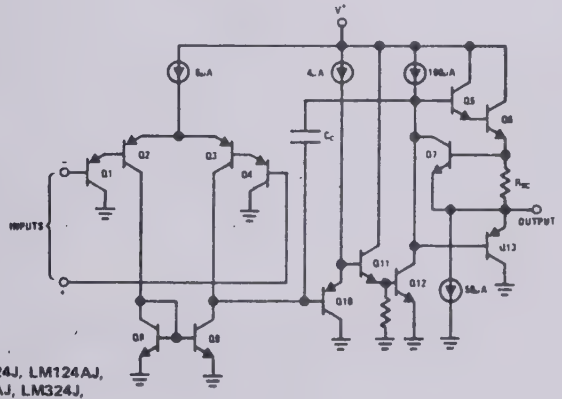
Order Number LM124D, LM124AD, LM224D or LM224AD
See Package 1

Order Number LM124F, LM124AF, LM224F or LM224AF
See Package 4

Order Number LM124J, LM124AJ, LM224J, LM224AJ, LM324J, LM324AJ or LM2902J
See Package 16

Order Number LM324N, LM324AN or LM2902N
See Package 22

schematic diagram (Each Amplifier)

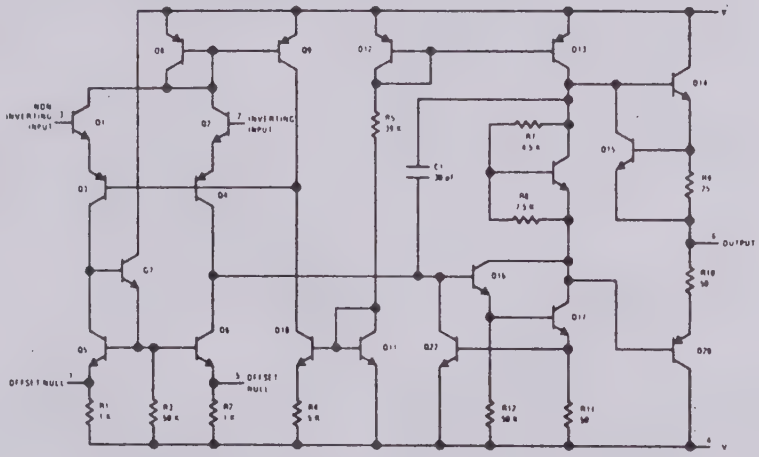


general description

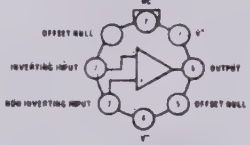
The LM741 series are general purpose operational amplifiers which feature improved performance over industry standards like the LM709. They are direct, plug-in replacements for the 709C, LM201, MC1439 and 748 in most applications.

The amplifiers offer many features which make their application nearly foolproof: overload protection on the input and output, no latch-up when the common mode range is exceeded, as well as freedom from oscillations.

schematic and connection diagrams (Top Views)



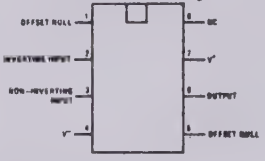
Metal Can Package



Note: Pin 4 connected to case.

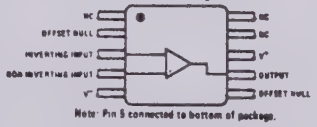
Order Number LM741H, LM741AH, LM741CH or LM741EH
See Package 11

Dual-In-Line Package



Order Number LM741CN or LM741EN
See Package 20
Order Number LM741CJ or LM741EJ
See Package 15

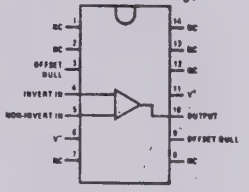
Flat Package



Note: Pin 5 connected to bottom of package.

Order Number LM741F or LM741AF
See Package 3

Dual-In-Line Package



Order Number LM741CD, LM741D, LM741AD or LM741ED
See Package 2B
Order Number LM741CN-14
See Package 22
Order Number LM741J-14, LM741AJ-14 LM741CJ-14 or LM741EJ-14
See Package 16

MC1590G

S-D P/N 025788

RF/IF/AUDIO AMPLIFIER

. . . an integrated circuit featuring wide-range AGC for use in RF/IF amplifiers and audio amplifiers over the temperature range, – 55 to +125°C. See Motorola Application Note AN-513 for design details.

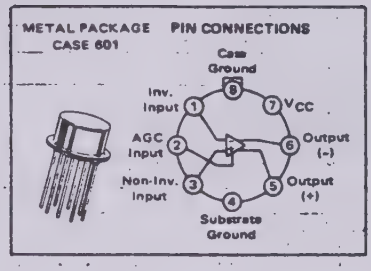
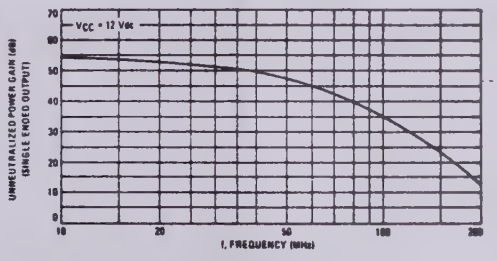
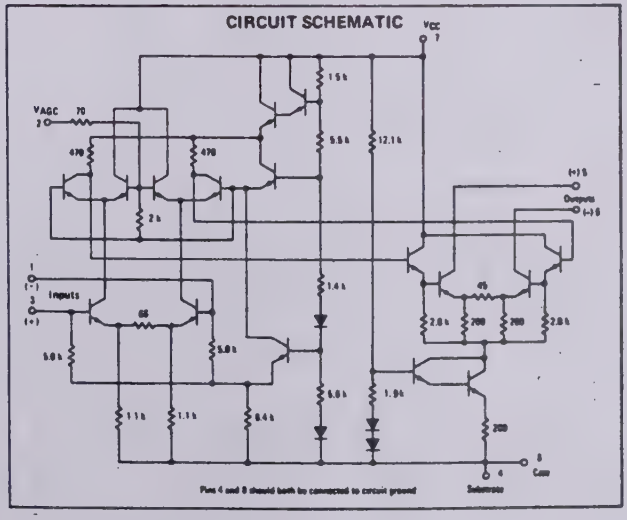


FIGURE 1 – UNNEUTRALIZED POWER GAIN versus FREQUENCY
(Tuned Amplifier, see Figure 16)



CIRCUIT SCHEMATIC



TTL QUAD 2-INPUT OR GATE

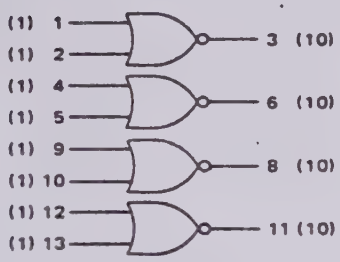
MC3002P S-D P/N 025739

P SUFFIX
PLASTIC PACKAGE
CASE 646

L SUFFIX
CERAMIC PACKAGE
CASE 632

F SUFFIX
CERAMIC PACKAGE
CASE 607

Quad 2-Input NOR Gate



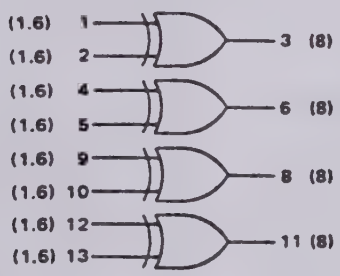
$3 = \overline{1 + 2}$

t_{pd} = 6.0 ns typ
P_D = 122 mW typ/pkg

TTL QUAD EXCLUSIVE OR GATE

MC3021 S-D P/N 025789

Quad 2-Input
Exclusive OR Gate



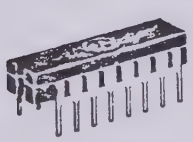
$3 = 1 \cdot \bar{2} + \bar{1} \cdot 2$

t_{pd} = 14 ns typ
P_D = 100 mW typ/pkg

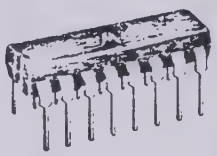
PROGRAMMABLE MODULO-N COUNTERS

MC4016
MC4018
MC74417
MC74419

S-D P/N 045237
S-D P/N



L SUFFIX
CERAMIC PACKAGE
CASE 620



P SUFFIX
PLASTIC PACKAGE
CASE 648
MC74416 thru MC74419

The monolithic devices are programmable, cascadable, modulo-N-counters. The MC54416/74416 can be programmed to divide by any number (N) from 0 thru 9, the MC54418/74418 from 0 thru 15. The MC54417/74417 consists of a modulo 2 counter which can be programmed to divide by 0 or 1 and a modulo 5 counter which can be programmed to divide by any number from 0 to 4. The MC54419/74419 contains two modulo 4 counters which can be programmed to divide by any number from 0 to 3.

The parallel enable ($\overline{PE}$) input enables the parallel data inputs D0 thru D3. All zeros are entered into the counter by applying a logic "0" level to the master reset ($\overline{MR}$) and $\overline{PE}$ inputs. This causes the counter to stop counting (count = 0). All data inputs are independent of the logic level of the Clock.

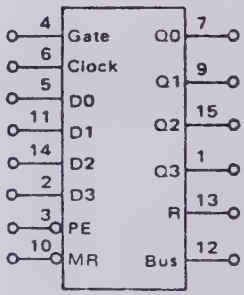
Modulo-N counters are useful in frequency synthesizers, in phase-locked loops, and in other applications where a simple method for frequency division is needed.

All Types:

Input Loading Factor:
Clock, $\overline{PE}$ = 2
D0, D1, D2, D3, Gate = 1
$\overline{MR}$ = 4
Output Loading Factor = 8

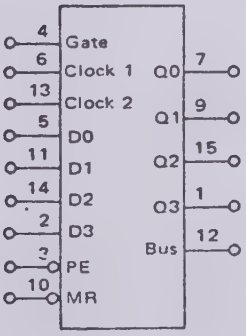
Total Power Dissipation = 250 mW typ/pkg
Propagation Delay Time:
Clock to Q3 = 50 ns typ
Clock to Bus = 35 ns typ

MC54416/74416
MC54418/74418



V_{CC} = Pin 16
Gnd = Pin 8

MC54417/74417
MC54419/74419



V_{CC} = Pin 16
Gnd = Pin 8

MC54416/74416

COUNT	OUTPUT			
	Q3	Q2	Q1	Q0
9	1	0	0	1
8	1	0	0	0
7	0	1	1	1
6	0	1	1	0
5	0	1	0	1
4	0	1	0	0
3	0	0	1	1
2	0	0	1	0
1	0	0	0	1
0	0	0	0	0

MC54418/74418

COUNT	OUTPUT			
	Q3	Q2	Q1	Q0
15	1	1	1	1
14	1	1	1	0
13	1	1	0	1
12	1	1	0	0
11	1	0	1	1
10	1	0	1	0
9	1	0	0	1
8	1	0	0	0
7	0	1	1	1
6	0	1	1	0
5	0	1	0	1
4	0	1	0	0
3	0	0	1	1
2	0	0	1	0
1	0	0	0	1
0	0	0	0	0

MC54417/74417

COUNT	OUTPUT
	Q0
1	1
0	0

COUNT	OUTPUT		
	Q3	Q2	Q1
4	1	0	0
3	0	1	1
2	0	1	0
1	0	0	1
0	0	0	0

MC54419/74419

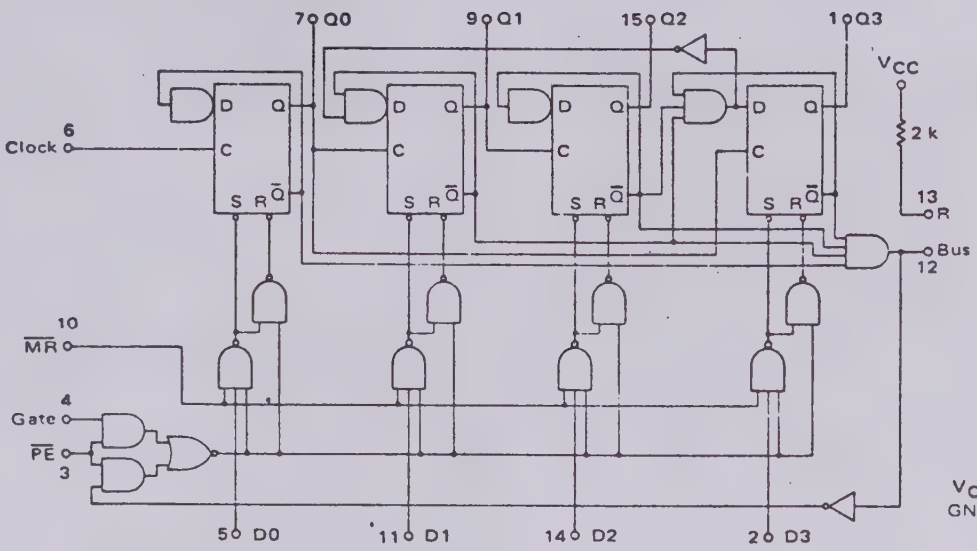
COUNT	OUTPUT	
	Q1	Q0
3	1	1
2	1	0
1	0	1
0	0	0

COUNT	OUTPUT	
	Q3	Q2
3	1	1
2	1	0
1	0	1
0	0	0

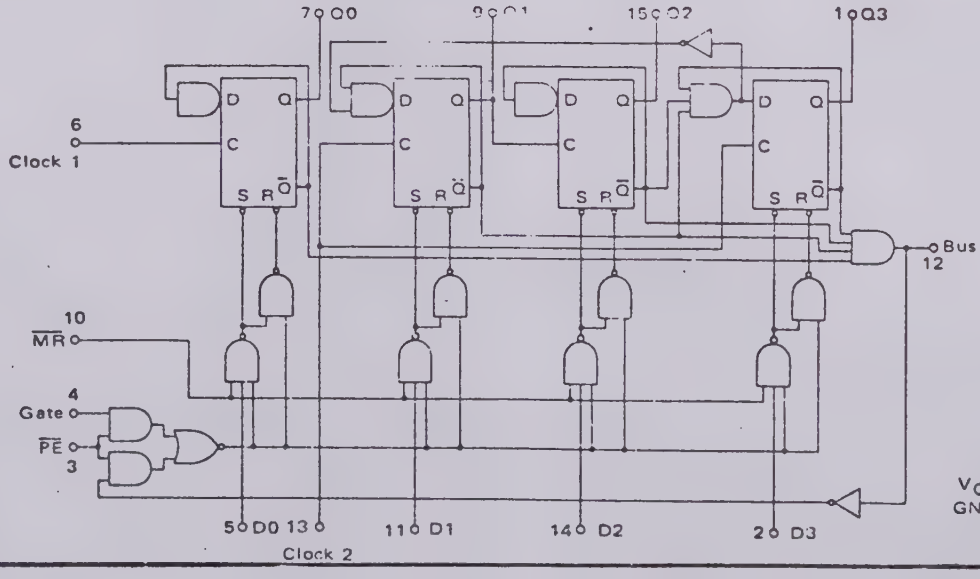
MC4016
MC4018
MC74417
MC74419

S-D P/N 045237
S-D P/N

MC54416/74416
(MC4016)



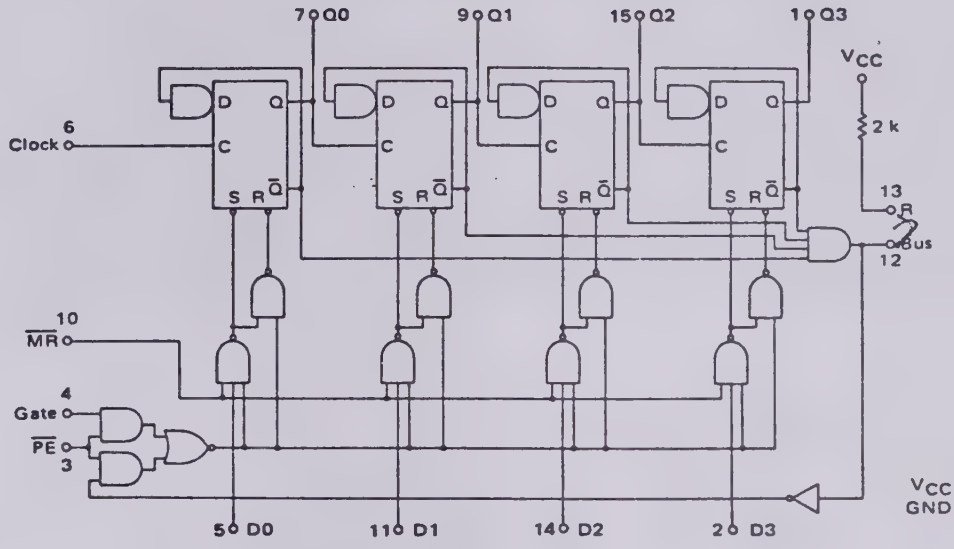
MC54417/74417



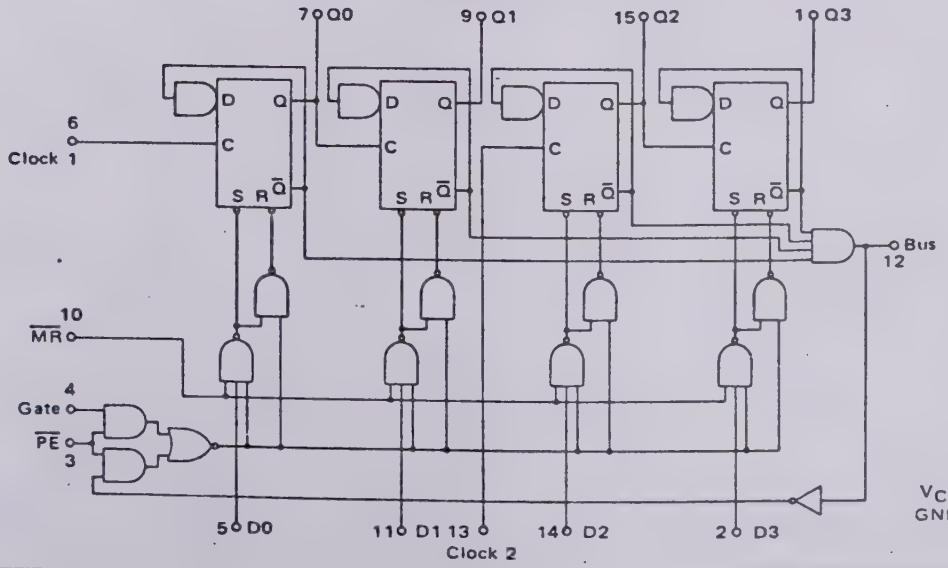
MC4016
MC4018
MC74417
MC74419

S-D P/N 045237
S-D P/N

MC54418/74418
(MC4018)



MC54419/74419



PHASE-FREQUENCY DETECTOR

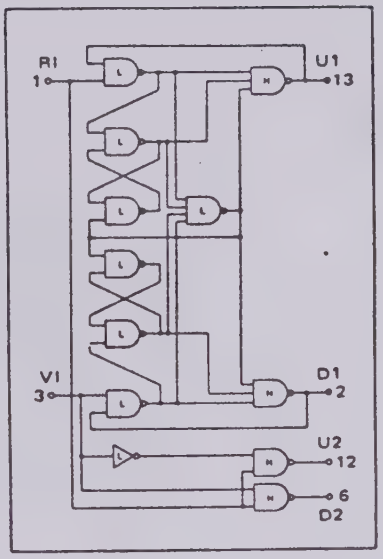
MC4044 S-D P/N 045238

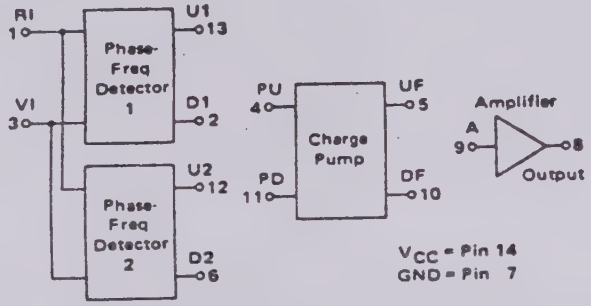
This device contains two digital phase detectors and a charge pump circuit which converts MTTL inputs to a dc voltage level for use in frequency discrimination and phase-locked-loop applications.

The two phase detectors have common inputs. Phase-frequency detector 1 is locked in (indicated by both outputs high) when the negative transitions of the variable input (VI) and reference input (RI) are equal in frequency and phase. If the variable input is lower in frequency or lags in phase, the U1 (up) output goes low; conversely the D1 (down) output goes low when the variable input is higher in frequency or leads the reference input in phase. It is important to note that the duty cycles of the variable input and the reference input are not important since negative transitions control system operation.

Phase detector 2, on the other hand, is locked in when the variable input phase lags the reference phase by 90° (indicated by the U2 and D2 outputs alternately going low with equal pulse widths). If the variable input phase lags by more than 90°, U2 will remain low longer than D2, and, conversely, if the variable input phase lags the reference phase by less than 90°, D2 remains low longer. In this phase detector the variable input and the reference must have 50% duty cycles.

The charge pump accepts the phase detector outputs (U1 or U2 applied to PU, and D1 or D2 applied to PD) and converts them to fixed amplitude positive and negative pulses at the UF and DF outputs respectively. These pulses are applied to a lag-lead active filter, which incorporates external components, as well as the amplifier provided in the MC4344/4044 circuit. The filter provides a dc voltage proportional to the phase error.



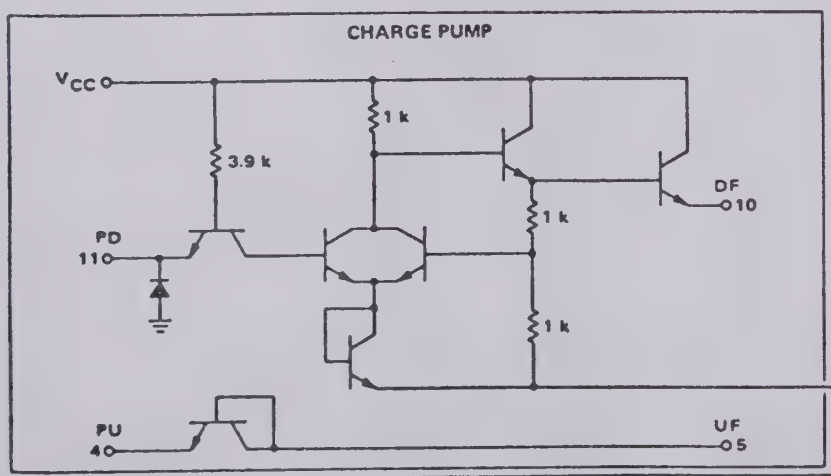


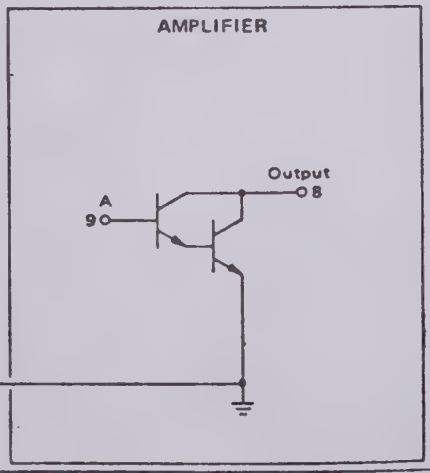
Input Loading Factor: RI, VI = 3

Output Loading Factor (Pin 8) = 10

Total Power Dissipation = 85 mW typ/pkg

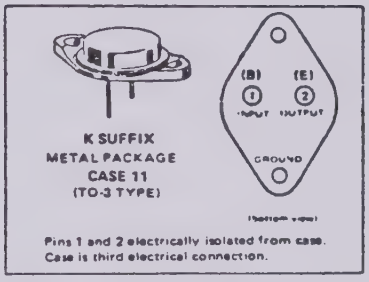
Propagation Delay Time = 9.0 ns typ
(thru phase detector)





MC7800C SERIES THREE-TERMINAL POSITIVE VOLTAGE REGULATORS

The MC7800C Series of three-terminal positive voltage regulators are monolithic integrated circuits designed as fixed-voltage regulators for a wide variety of applications including local, on-card regulation. Available in seven fixed output voltage options from 5.0 - to - 24 volts, these regulators employ internal current limiting, thermal shutdown, and safe area compensation – making them essentially blow-out proof. With adequate heatsinking they can deliver output currents in excess of 1.0 ampere. The last two digits of the part number indicate nominal output voltage.



K SUFFIX
METAL PACKAGE
CASE 11
(TO-3 TYPE)

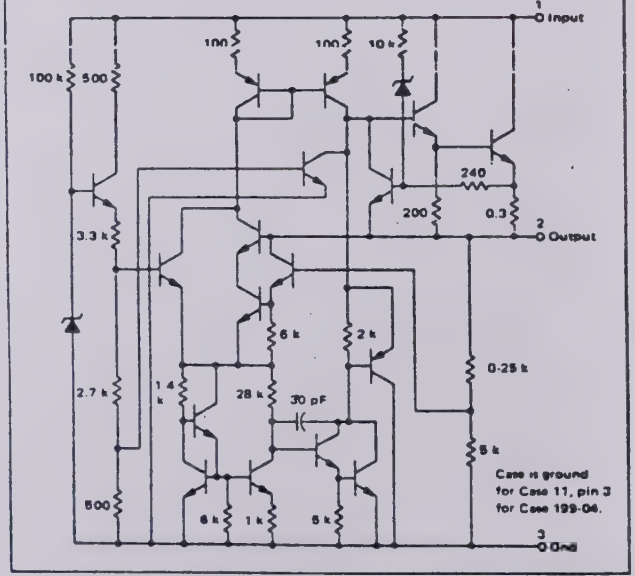
Pins 1 and 2 electrically isolated from case.
Case is third electrical connection.

P SUFFIX
PLASTIC PACKAGE
CASE 199-04

Pin 1 Input (Base)
Pin 2 Output (Emitter)
Pin 3 Ground (Collector)

Heat sink surface connected to pin 3.

SCHEMATIC DIAGRAM



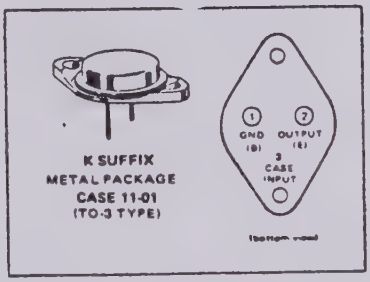
TYPE NO./VOLTAGE

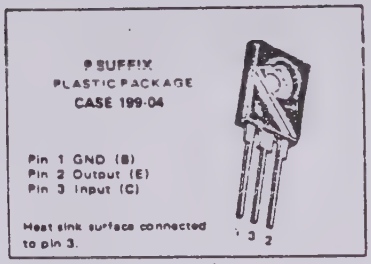
MC7805C 5.0 Volts	MC7808C 8.0 Volts	MC7818C 18 Volts
MC7806C 6.0 Volts	MC7812C 12 Volts	MC7824C 24 Volts
	MC7815C 15 Volts	

MC7900C SERIES THREE-TERMINAL NEGATIVE VOLTAGE REGULATORS

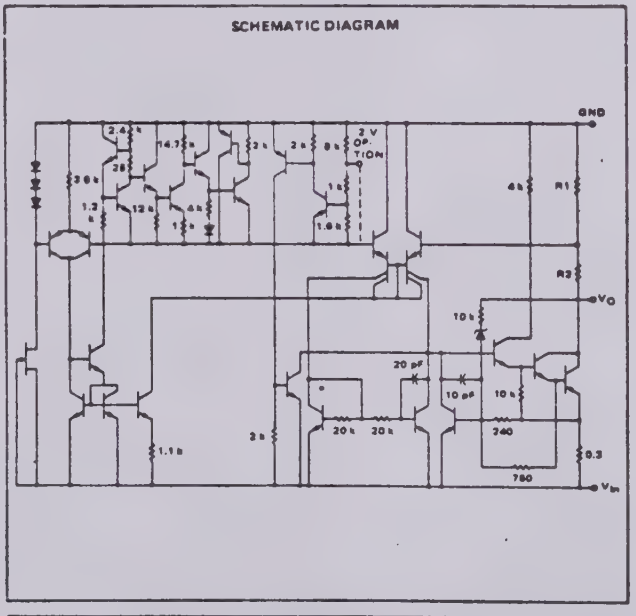
The MC7900C Series of fixed output negative voltage regulators are intended as complements to the popular MC7800C Series devices. These negative regulators are available in the same seven-voltage options as the MC7800C devices. In addition, two extra voltage options commonly employed in MECL systems are also available in the negative MC7900C Series.

Available in fixed output voltage options from -2.0 to -24 volts, these regulators employ current limiting, thermal shutdown, and safe-area compensation – making them remarkably rugged under most operating conditions. With adequate heat-sinking they can deliver output currents in excess of 1.0 ampere.





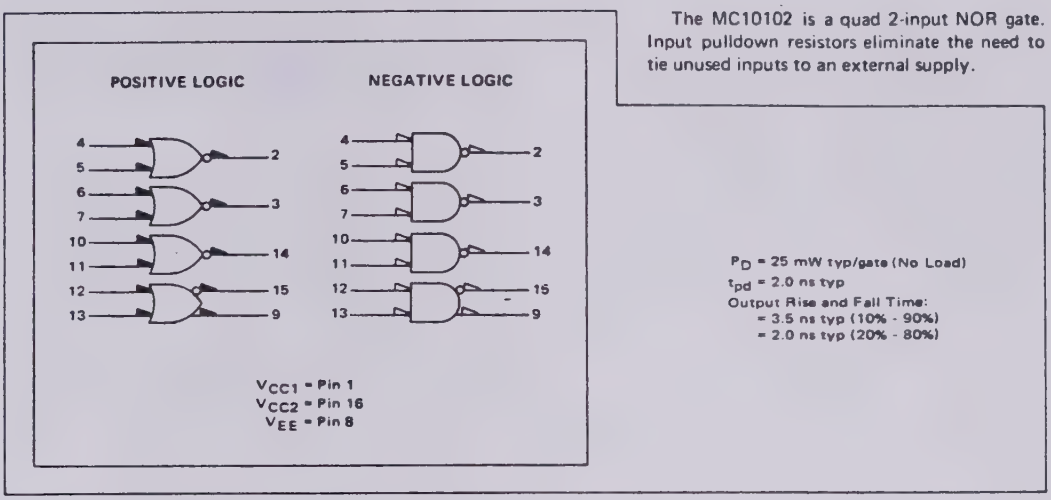
SCHEMATIC DIAGRAM



DEVICE TYPE/NOMINAL OUTPUT VOLTAGE		
MC7902C - 2.0 Volts	MC7906C - 6.0 Volts	MC7915C - 15 Volts
MC7905C - 5.0 Volts	MC7908C - 8.0 Volts	MC7918C - 18 Volts
MC7905.2C - 5.2 Volts	MC7912C - 12 Volts	MC7924C - 24 Volts

ECL QUAD 2-INPUT NOR GATE

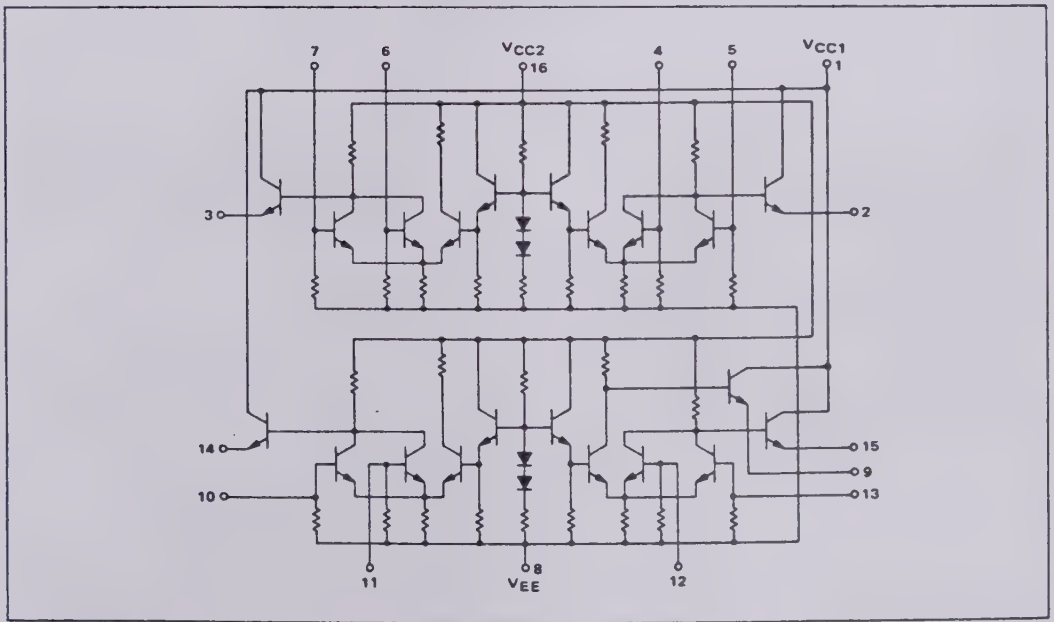
MC10102 S-D P/N 103025



The MC10102 is a quad 2-input NOR gate. Input pulldown resistors eliminate the need to tie unused inputs to an external supply.

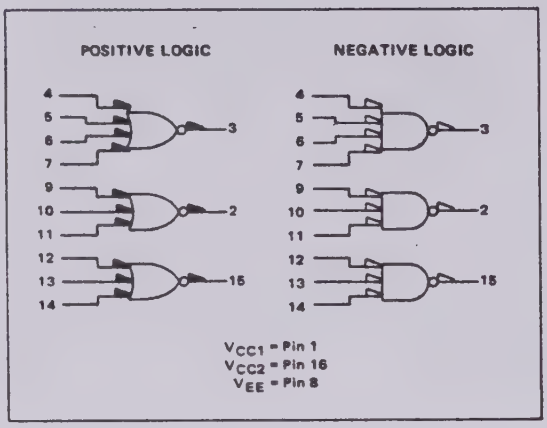
P_D = 25 mW typ/gate (No Load)
t_{pd} = 2.0 ns typ
Output Rise and Fall Time:
= 3.5 ns typ (10% - 90%)
= 2.0 ns typ (20% - 80%)

CIRCUIT SCHEMATIC



ECL TRIPLE 4-3-3 INPUT NOR GATE

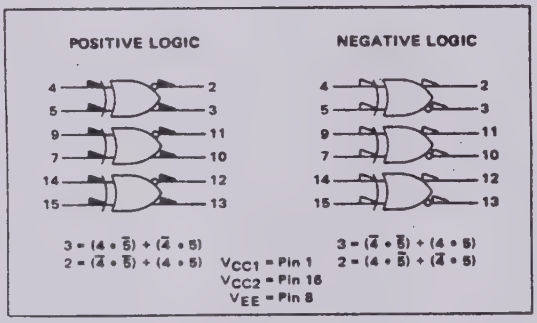
MC10106 S-D P/N 103168



The MC10106 is a triple 4-3-3 input NOR gate. Input pulldown resistors eliminate the need to tie unused inputs to an external supply.

TRIPLE 2-INPUT EXCLUSIVE "OR"/EXCLUSIVE "NOR"

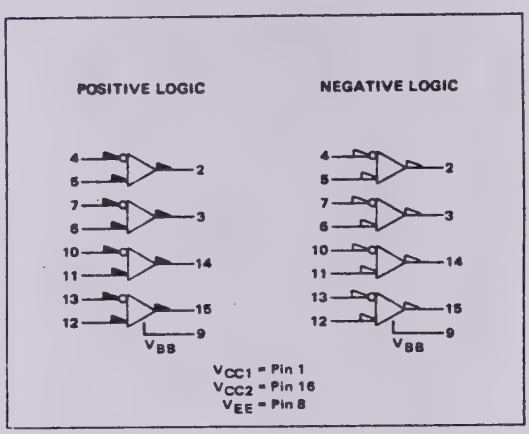
MC10107 S-D P/N



This three gate array is designed to provide the positive logic Exclusive OR and Exclusive NOR functions in high speed applications. Input pulldown resistors eliminate the need to tie unused inputs to V_{EE}.

ECL QUAD LINE RECEIVER

MC10115 **S-D P/N 045254**

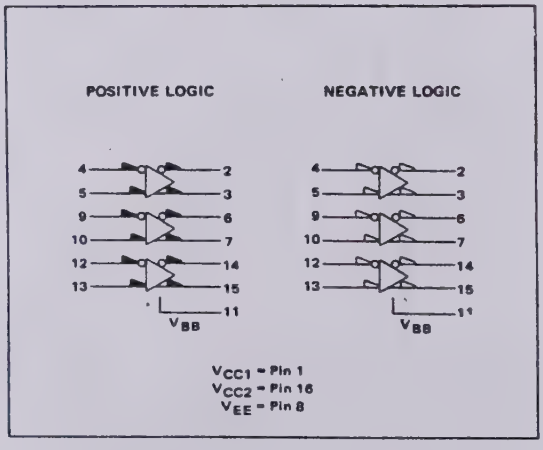


The MC10115 is a quad differential amplifier designed for use in sensing differential signals over long lines. The base bias supply (V_{BB}) is made available at pin 9 to make the device useful as a Schmitt trigger, or in other applications where a stable reference voltage is necessary.

Active current sources provide the MC10115 with excellent common mode noise rejection. If any amplifier in a package is not used, one input of that amplifier must be connected to V_{BB} (pin 9) to prevent upsetting the current source bias network.

TRIPLE LINE RECEIVER

MC10116 **S-D P/N**

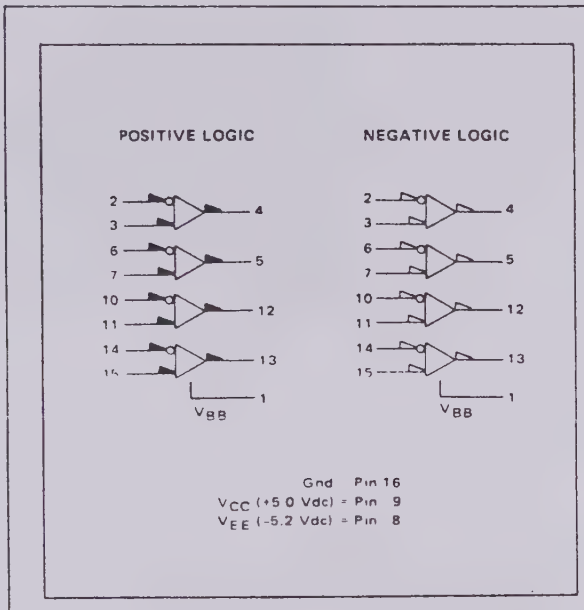


The MC10116 is a triple differential amplifier designed for use in sensing differential signals over long lines. The base bias supply (V_{BB}) is made available at pin 11 to make the device useful as a Schmitt trigger, or in other applications where a stable reference voltage is necessary.

Active current sources provide the MC10116 with excellent common mode noise rejection. If any amplifier in a package is not used, one input of that amplifier must be connected to V_{BB} (pin 11) to prevent upsetting the current source bias network.

Complementary outputs are provided to allow driving twisted pair lines, to enable cascading of several amplifiers in a chain, or simply to provide complement outputs of the input logic function.

ECL QUAD ECL-TO-TTL TRANSLATOR



The MC10125 is a quad translator for interfacing data and control signals between the MECL section and saturated logic sections of digital systems. The MC10125 incorporates differential inputs and Schottky MTTL "totem pole" outputs. Differential inputs allow for use as an inverting/non-inverting translator or as a differential line receiver. The V_{BB} reference voltage is available on pin 1 for use in Schmitt trigger applications and single-ended input biasing. The outputs of the MC10125 go to a low logic level whenever the inputs are left floating.

Power supply requirements are ground, +5.0 Volts and -5.2 Volts. Propagation delay of the MC10125 is typically 5.0 ns. The MC10125 has fanout of 10 MTTL loads. The dc levels are MECL 10,000 in and Schottky TTL, or MTTL out. This device has an input common mode noise rejection of ±1.0 Volt.

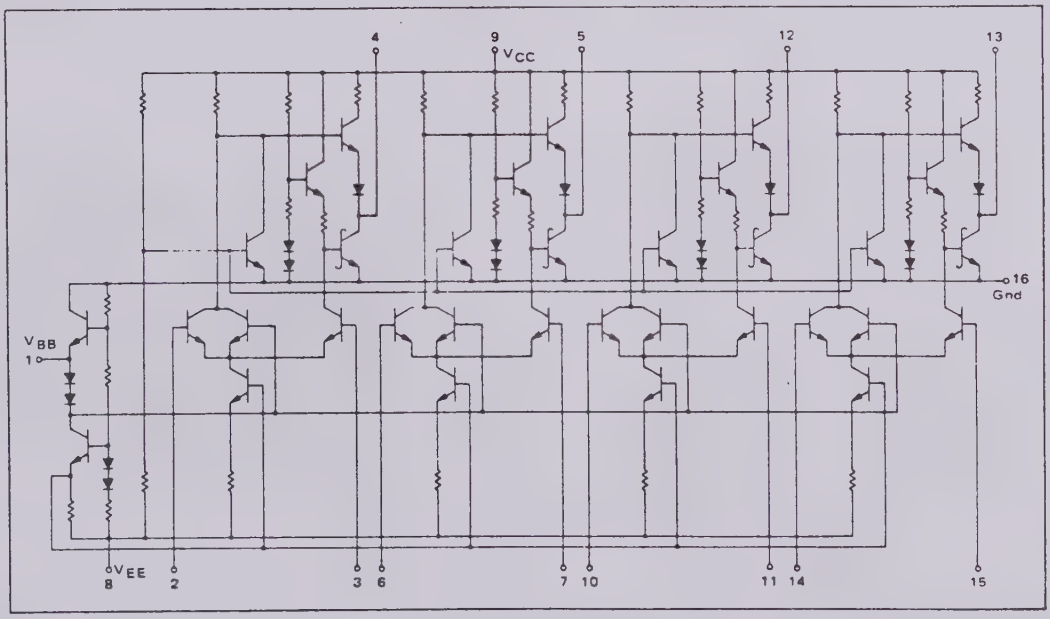
An advantage of this device is that MECL level information can be received, via balanced twisted pair lines, in the MTTL equipment. This isolates the MECL logic from the noisy MTTL environment. This device is useful in computers, instrumentation, peripheral controllers, test equipment and digital communications systems.

P_D = 380 mW typ/pkg (No Load)

t_{pd} = 4.5 ns typ (50% to +1.5 Vdc out)

Output Rise, Fall Times,
2.5 ns typ (20% to 80%)

CIRCUIT SCHEMATIC



R-S TRUTH TABLE

R	S	Q_{n+1}
L	L	Q_n
L	H	H
H	L	L
H	H	N.D.

N.D. = Not Defined

CLOCKED TRUTH TABLE

C	D	Q_{n+1}
L	ϕ	Q_n
H	L	L
H	H	H

ϕ = Don't Care

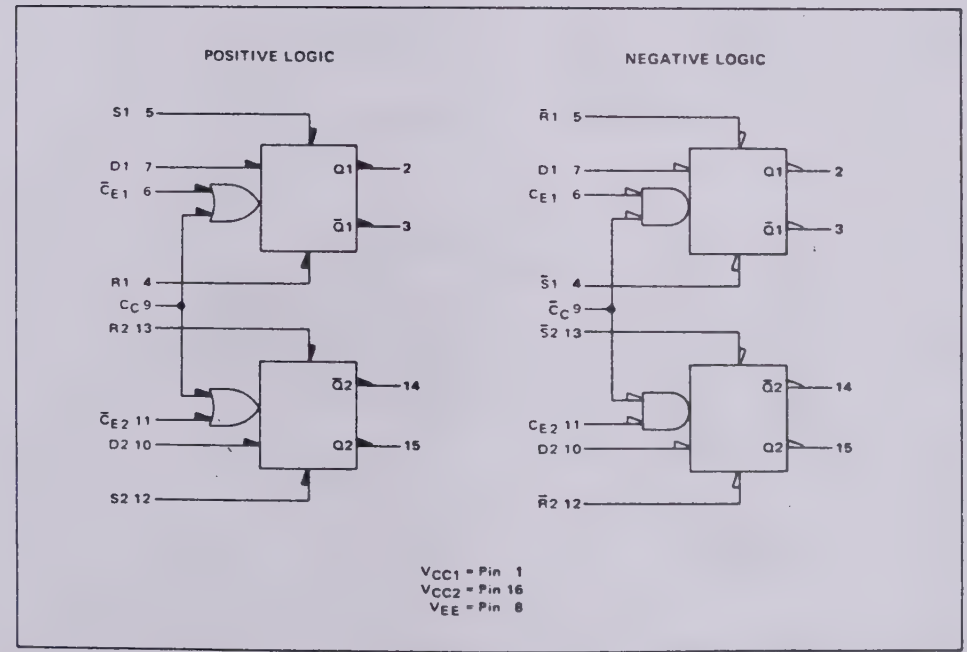
$C = \bar{C}_E + C_C$

A clock H is a clock transition from a low to a high state.

The MC10131 is a dual master-slave type D flip-flop. Asynchronous Set (S) and Reset (R) override Clock (C_C) and Clock Enable ($\bar{C}_E$) inputs. Each flip-flop may be clocked separately by holding the common clock in the low state and using the enable inputs for the clocking function. If the common clock is to be used to clock the flip-flop, the Clock Enable inputs must be in the low state. In this case, the enable inputs perform the function of controlling the common clock.

The output states of the flip-flop change on the positive transition of the clock. A change in the information present at the data (D) input will not affect the output information at any other time due to master slave construction.

Input pulldown resistors eliminate the need to tie unused inputs to V_{EE}. Output rise and fall times have been optimized to provide relaxation of system design and layout criteria.



The MC10137 is a high speed synchronous counter that can count up, count down, preset, or stop count at frequencies exceeding 100 MHz. This decade counter is useful in high speed central processors and peripheral controllers, minicomputers, high speed digital communications equipment and instrumentation. The flexibility of this device allows the designer to use one basic counter for most applications. The synchronous count feature makes the MC10137 suitable for either computers or instrumentation.

Three control lines (S1, S2, and $\overline{\text{Carry In}}$) determine the operation mode of the counter. Lines S1 and S2 determine one of four operations; preset (program), increment (count up), decrement (count down), or hold (stop count). Note that in the preset mode a clock pulse is necessary to load the counter, and the information present on the data inputs (D0, D1, D2, and D3) will be entered into the counter. $\overline{\text{Carry Out}}$ goes low on the terminal count. The $\overline{\text{Carry Out}}$ on the MC10137 is partially decoded from Q1 and Q2 directly, so in the preset mode the condition of the $\overline{\text{Carry Out}}$ after the Clock's positive excursion will depend on the condition of Q1 and/or Q2

When an output is not needed, it can be left open to conserve system power. (The open emitter output will require no power if left open.) The counter changes state only on the positive going edge of the clock. Any other input may change at any time except during the positive transition of the clock. The sequence for counting out of improper states is as shown in the State Diagrams.

A prescaler can be constructed using the MC10137 in conjunction with the MC10231 which will operate at over 200 MHz input frequency. A 500 MHz prescaler is possible using an MC1690 500 MHz D Flip-Flop, an MC1670 300 MHz D Flip-Flop, and the MC10137.

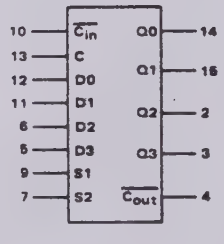
SEQUENTIAL TRUTH TABLE*

INPUTS								OUTPUTS				
S1	S2	D0	D1	D2	D3	$\overline{\text{Carry In}}$	Clock **	Q0	Q1	Q2	Q3	$\overline{\text{Carry Out}}$
L	L	H	H	H	L	ϕ	H	H	H	H	L	H
L	H	◇	ϕ	ϕ	ϕ	L	H	L	L	L	H	H
L	H	ϕ	ϕ	ϕ	ϕ	L	H	H	L	L	H	L
L	H	ϕ	ϕ	ϕ	ϕ	L	H	L	L	L	L	H
L	H	ϕ	ϕ	ϕ	ϕ	L	H	H	L	L	L	H
L	H	ϕ	ϕ	ϕ	ϕ	H	H	H	L	L	L	H
L	H	ϕ	ϕ	ϕ	ϕ	H	H	H	L	L	L	H
H	H	ϕ	ϕ	ϕ	ϕ	H	H	H	L	L	L	H
H	L	ϕ	H	L	L	H	H	H	L	L	L	H
H	L	ϕ	ϕ	ϕ	ϕ	L	H	L	H	L	L	H
H	L	ϕ	ϕ	ϕ	ϕ	L	H	H	L	L	L	H
H	L	ϕ	ϕ	ϕ	ϕ	L	H	L	L	L	L	L

ϕ = Don't care.

* Truth table shows logic states assuming inputs vary in sequence shown from top to bottom.

** A clock H is defined as a clock input transition from a low to a high logic level.



V_{CC1} = Pin 1
V_{CC2} = Pin 16
V_{EE} = Pin 8

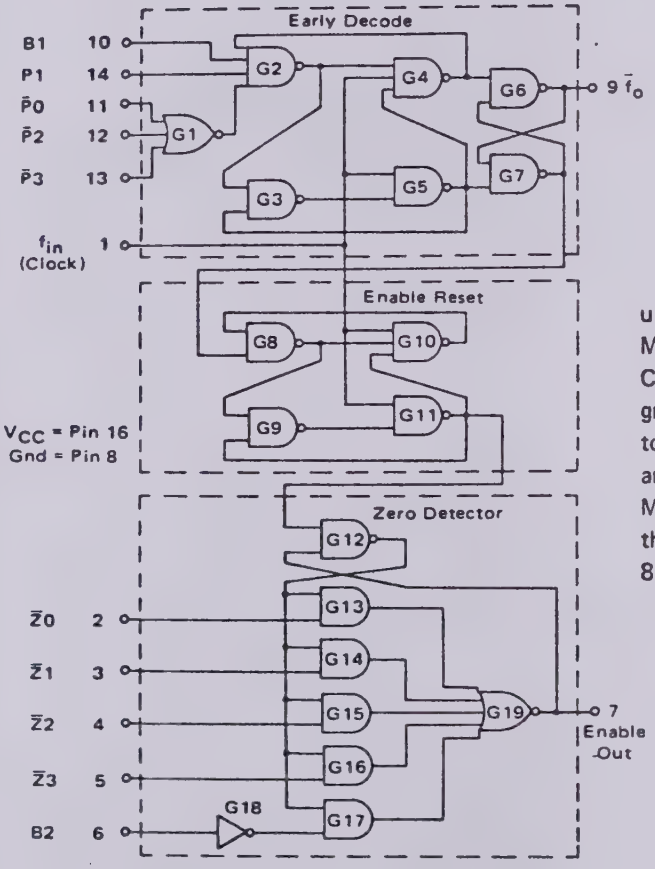
FUNCTION SELECT TABLE

S1	S2	Operating Mode
L	L	Preset (Program)
L	H	Increment (Count Up)
H	L	Decrement (Count Down)
H	H	Hold (Stop Count)

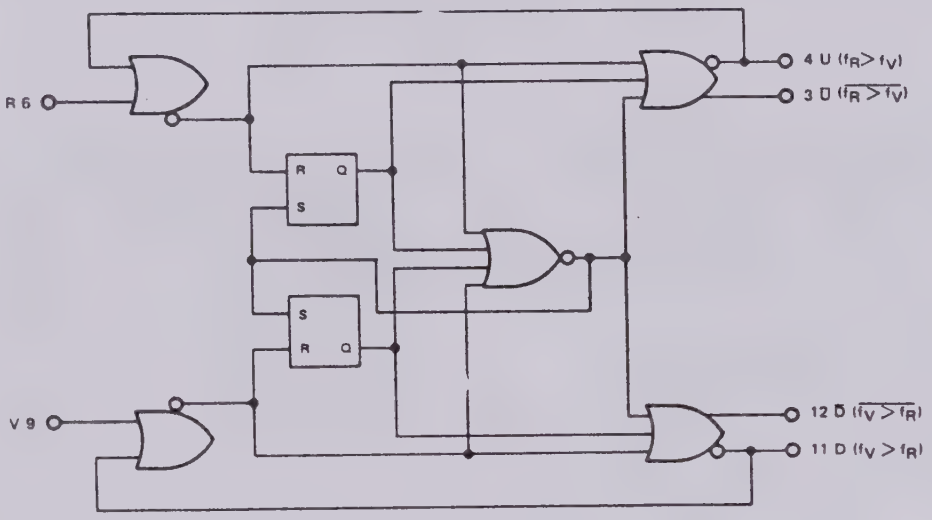
P_D = 625 mW typ/pkg (No Load)
f_{count} = 150 MHz typ

MC12014L S-D P/N 045263

MC12014 Counter Control Logic



The MC12014 monolithic counter control logic unit is designed for use with the MC12012 Two-Modulus Prescaler and the MC4016 Programmable Counter to accomplish direct high-frequency programming. The MC12014 consists of a zero detector which controls the modulus of the MC12012, and an early decode function which controls the MC4016. The early decode feature also increases the useful frequency range of the MC4016 from 8.0 MHz to 25 MHz.



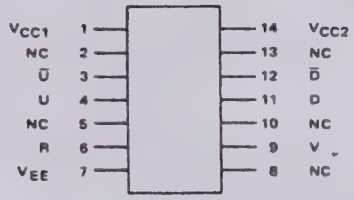
V_{CC1} = Pin 1
V_{CC2} = Pin 14
V_{CC3} = Pin 7

The MC12040 is a logic network designed for use as a phase comparator for MECL-compatible input signals. It determines the "lead" or "lag" phase relationship and the time difference between the leading edges of the waveforms. Since these edges occur only once per cycle, the detector has a range of $\pm 2\pi$ radians.

Operation of the device may be illustrated by assuming two waveforms, R and V (Figure 1), of the same frequency but differing in phase. If the logic had established by past history that R was leading V, the U output of the detector (pin 4) would produce a positive pulse width equal to the phase difference and the D output (pin 11) would simply remain low.

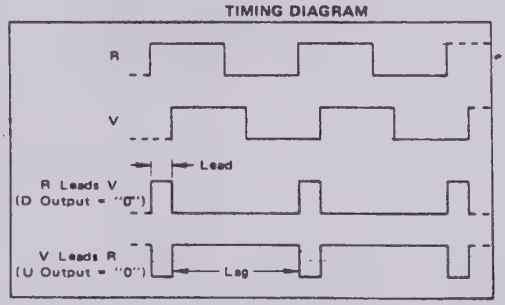
On the other hand, it is also possible that V was leading R (Figure 1), giving rise to a positive pulse on the D output and a constant low level on the U output pin. Both outputs for the sample condition are valid since the determination of lead or lag is dependent on past edge crossing and initial conditions at start-up. A stable phase-locked loop will result from either condition.

Phase error information is contained in the output duty cycle – that is, the ratio of the output pulse width to total period. By integrating or low-pass filtering the outputs of the detector and shifting the level to accommodate ECL swings, usable analog information for the voltage-controlled oscillator can be developed.

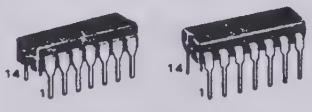


NC – No Connection

TIMING DIAGRAM



MC14001AL
MC14001CL
MC14001CP



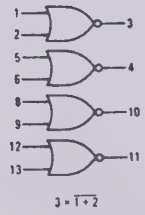
L SUFFIX
CERAMIC PACKAGE
CASE 632

P SUFFIX
PLASTIC PACKAGE
CASE 646

QUAD 2-INPUT "NOR" GATE

The MC14001 quad 2-input NOR gate is constructed with MOS P-channel and N-channel enhnacement mode devices in a single monolithic structure. These complementary MOS logic gates find primary use where low power dissipation and/or high noise immunity is desired.

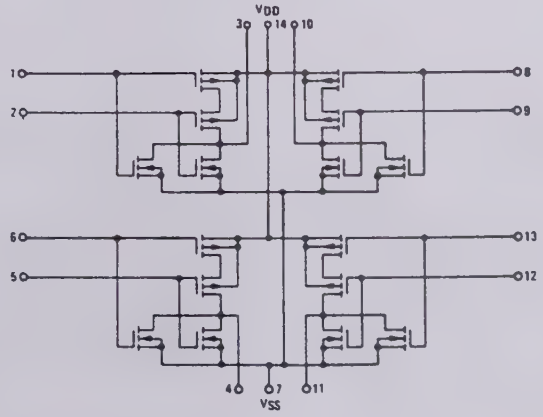
LOGIC DIAGRAM
POSITIVE LOGIC



$3 = \overline{1+2}$

V_{DD} = Pin 14
V_{SS} = Pin 7

CIRCUIT SCHEMATIC



MC14013AL
MC14013CL
MC14013CP

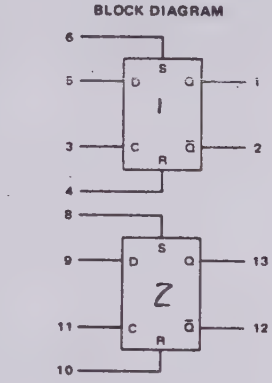
L SUFFIX
CERAMIC PACKAGE
CASE 632

P SUFFIX
PLASTIC PACKAGE
CASE 646

DUAL TYPE D FLIP-FLOP

The MC14013 dual type D flip-flop is constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic structure. Each flip-flop has independent Data, (D), Direct Set, (S), Direct Reset, (R), and Clock (C) inputs and complementary outputs (Q and $\overline{Q}$). These devices may be used as shift register elements or as type T flip-flops for counter and toggle applications.

BLOCK DIAGRAM



V_{DD} = Pin 14
V_{SS} = Pin 7

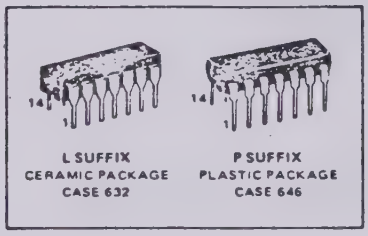
TRUTH TABLE

INPUTS				OUTPUTS	
CLOCK†	DATA	RESET	SET	Q	$\overline{Q}$
↑	0	0	0	0	1
↑	1	0	0	1	0
↓	X	0	0	Q	$\overline{Q}$
X	X	1	0	0	1
X	X	0	1	1	0
X	X	1	1	1	1

No Change

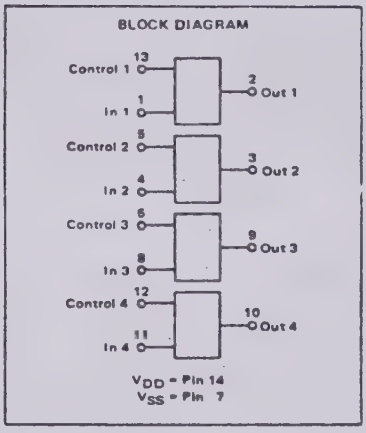
X = Don't Care
† = Level Change

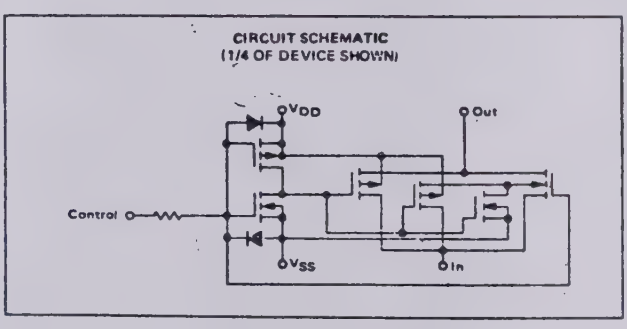
MC14016AL
MC14016CL
MC14016CP

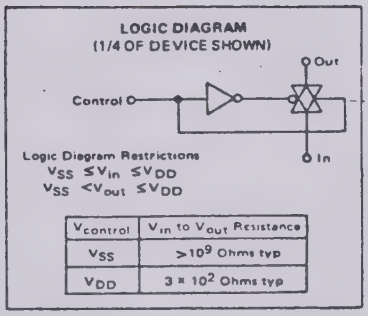


QUAD ANALOG SWITCH/QUAD MULTIPLEXER

The MC14016 quad bilateral switch is constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic structure. Each MC10416 consists of four independent switches capable of controlling either digital or analog signals. The quad bilateral switch is used in signal gating, chopper, modulator, demodulator and CMOS logic implementation.

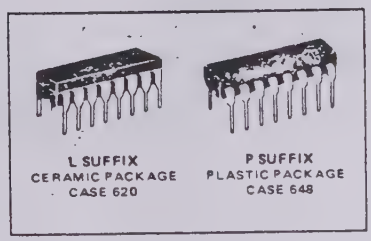






$V_{control}$	V_{in} to V_{out} Resistance
V_{SS}	$>10^9$ Ohms typ
V_{DD}	3×10^2 Ohms typ

MC14028AL
MC14028CL
MC14028CP



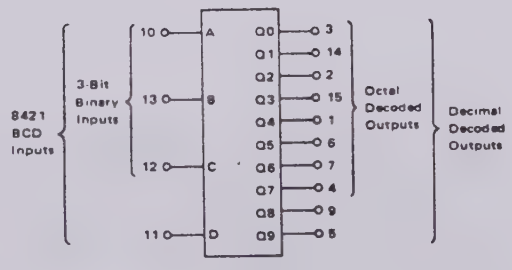
L SUFFIX
CERAMIC PACKAGE
CASE 620

P SUFFIX
PLASTIC PACKAGE
CASE 648

BCD-TO-DECIMAL DECODER
BINARY-TO-OCTAL DECODER

The MC14028 decoder is constructed so that an 8421 BCD code on the four inputs provides a decimal (one-of-ten) decoded output, while a 3-bit binary input provides a decoded octal (one-of-eight) code output with D forced to a logic "0". Expanded decoding such as binary-to-hexadecimal (one-of-16), etc., can be achieved by using other MC14028 devices. The part is useful for code conversion, address decoding, memory selection control, demultiplexing, or readout decoding.

BLOCK DIAGRAM



V_{DD} = Pin 16
V_{SS} = Pin 8

TRUTH TABLE

INPUT				OUTPUT									
D	C	B	A	Q9	Q8	Q7	Q6	Q5	Q4	Q3	Q2	Q1	Q0
0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	1	0	0	0	0	0	0	0	0	1	0
0	0	1	0	0	0	0	0	0	0	0	1	0	0
0	0	1	1	0	0	0	0	0	0	1	0	0	0
0	1	0	0	0	0	0	0	0	1	0	0	0	0
0	1	0	1	0	0	0	0	1	0	0	0	0	0
0	1	1	0	0	0	0	1	0	0	0	0	0	0
0	1	1	1	0	0	1	0	0	0	0	0	0	0
1	0	0	0	0	1	0	0	0	0	0	0	0	0
1	0	0	1	1	0	0	0	0	0	0	0	0	0
1	0	1	0	0	0	0	0	0	0	0	0	0	0
1	0	1	1	0	0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0	0	0	0	0	0
1	1	0	1	0	0	0	0	0	0	0	0	0	0
1	1	1	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	0	0	0	0	0	0	0	0	0	0

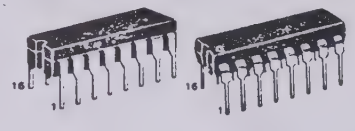
MC14049
MC14050

S-D P/N 103217
S-D P/N 103492

HEX BUFFERS

The MC14049B hex inverter/buffer and MC14050B noninverting hex buffer are constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic structure. These complementary MOS devices find primary use where low power dissipation and/or high noise immunity is desired. These devices provide logic-level conversion using only one supply voltage, V_{CC}. The input-signal high level (V_{IH}) can exceed the V_{CC} supply voltage for logic-level conversions. Two TTL/DTL Loads can be driven when the devices are used as CMOS-to-TTL/DTL converters (V_{CC} = 5.0 V, $V_{OL} \leq$ 0.4 V, $I_{OL} \geq$ 3.2 mA). Note that pin 16 is not connected internally on these devices; consequently connections to this terminal will not affect circuit operation.

- High Source and Sink Currents
- High-to-Low Level Converter
- Quiescent Current = 2.0 nA/package typical @ 5 Vdc
- Supply Voltage Range = 3.0 Vdc to 18 Vdc



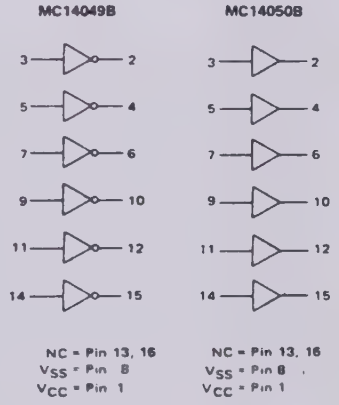
L SUFFIX
CERAMIC PACKAGE
CASE 620

P SUFFIX
PLASTIC PACKAGE
CASE 648

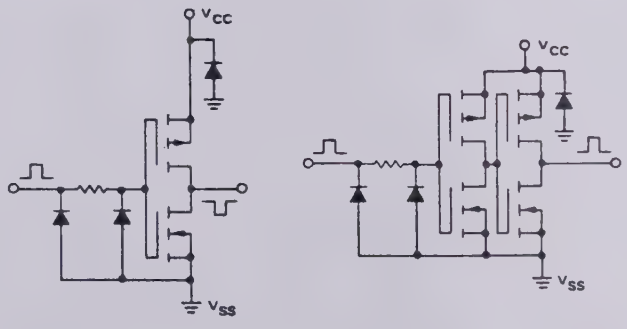
ORDERING INFORMATION

MC14XXXB — Suffix Denotes
- L Ceramic Package
- P Plastic Package
- A Extended Operating Temperature Range
- C Limited Operating Temperature Range

LOGIC DIAGRAMS

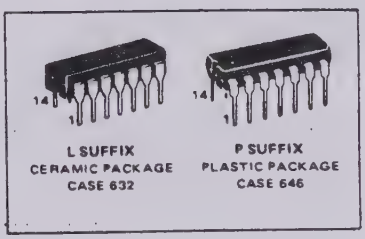


CIRCUIT SCHEMATIC
(1/6 OF CIRCUIT SHOWN)



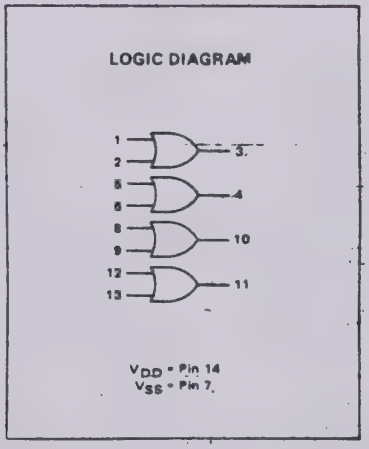
MC14071 S-D P/N 103940

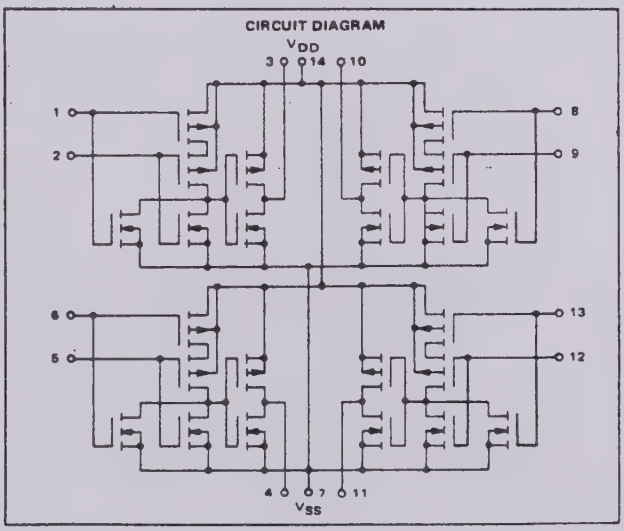
MC14071AL
MC14071CL
MC14071CP



QUAD 2-INPUT "OR" GATE

The MC14071 quad 2-input OR gate is constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic structure. These complementary MOS logic gates find primary use where low power dissipation and/or high noise immunity is desired.





MC14433

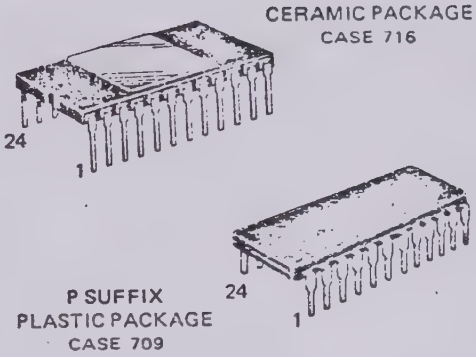
S-D P/N 117326

3½ DIGIT A/D CONVERTER

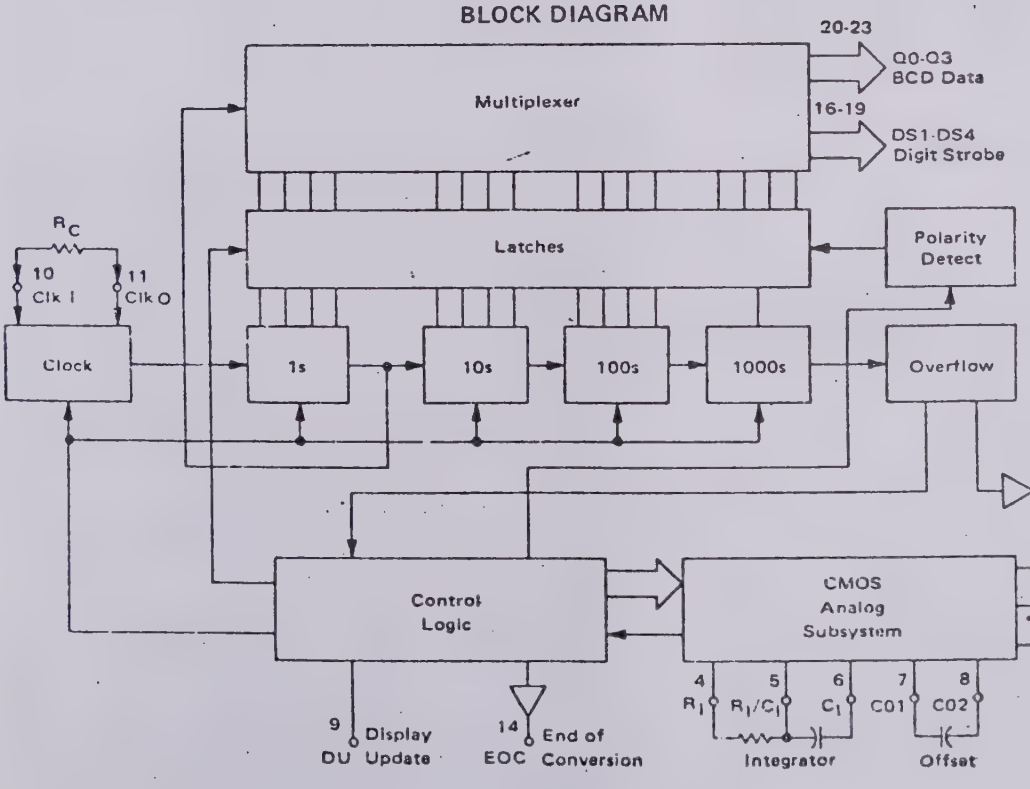
The MC14433 is a high performance, low power, 3½ digit A/D converter combining both linear CMOS and digital CMOS circuits on a single monolithic IC. The MC14433 is designed to minimize use of external components. With two external resistors and two external capacitors, the system forms a dual slope A/D converter with automatic zero correction and automatic polarity.

The MC14433 is ratiometric and may be used over a full-scale range from 1.999 volts to 199.9 millivolts. Systems using the MC14433 may operate over a wide range of power supply voltages for ease of use with batteries, or with standard 5 volt supplies. The output drive conforms with standard B-Series CMOS specifications and can drive a low-power Schottky TTL load.

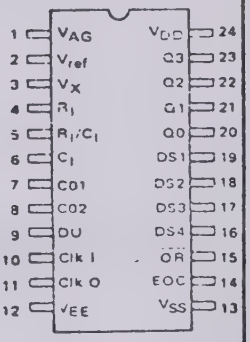
The high impedance MOS inputs allow applications in current and resistance meters as well as voltmeters. In addition to DVM/DPM applications, the MC14433 finds use in digital thermometers, digital scales, remote A/D, A/D control systems, and in MPU systems.



BLOCK DIAGRAM



PIN ASSIGNMENT



DEVICE OPERATION

ANALOG GROUND (V_{AG}, Pin 1)

Analog ground at this pin is the input reference level for the unknown input voltage (V_X) and reference voltage (V_{ref}). This pin is a high impedance input.

REFERENCE VOLTAGE (V_{ref}, Pin 2)
UNKNOWN INPUT VOLTAGE (V_X, Pin 3)

This A/D system performs a ratiometric A/D conversion; that is, the unknown input voltage, V_X, is measured as a ratio of the reference voltage, V_{ref}. The full scale voltage is equal to that voltage applied to V_{ref}. Therefore, a full scale voltage of 1.999 V requires a reference voltage of 2.000 V while full scale voltage of 199.9 mV requires a reference voltage of 200 mV. Both V_X and V_{ref} are high impedance inputs. In addition to being a reference input, pin 2 functions as a reset for the A/D converter. When pin 2 is switched to V_{EE}, the system is reset to the beginning of a conversion cycle.

EXTERNAL COMPONENTS (R_I, R_I/C_I, C_I; Pins 4, 5, 6)

These pins are for external components for the integration used in the dual ramp A/D conversion. A typical value for the capacitor is 0.1 μF (mylar) while the resistor should be 470 kΩ for 2.0 V full scale operation and 27 kΩ for 200 mV full scale operation. These values are for a 66 kHz clock frequency which will produce a conversion time of approximately 250 ms. The equations governing the calculation for the values for integrator components are as follows:

$$R_I = \frac{V_X(max)}{C_I} \times \frac{T}{\Delta V}$$

$$\Delta V = V_{DD} - V_X(max) - 0.5$$

$$T = 4000 \times \frac{1}{f_{Clk}}$$

where:

V_{DD} is the voltage at pin 24 referenced to V_{AG}
V_X is the voltage at pin 3 referenced to V_{AG}
f_{Clk} is the clock frequency at pin 10

Example:

$C_I = 0.1\ \mu F$
$V_{DD} = 5.0$ volts
$f_{Clk} = 66$ kHz
For $V_X(max) = 2.0$ volts
$R_I = 480$ kΩ (use 470 k$\Omega \pm 5\%$)
For $V_X(max) = 200$ mV
$R_I = 28$ kΩ (use 27 k$\Omega \pm 5\%$)

Note that for worst case conditions, the minimum allowable value for R_I is a function of C_I min, V_{DD} min, and f_{Clk} max. The worst-case condition does not allow $V + V_X$ to exceed V_{DD}. The 0.5 V factor in the above equation for ΔV is for safety margin.

OFFSET CAPACITOR (CO1, CO2; Pins 7, 8)

These pins are used for connecting the offset correction capacitor. The recommended value is 0.1 μF.

DISPLAY UPDATE INPUT (DU, Pin 9)

If a positive edge is received on this input prior to the ramp-down cycle, new data will be strobed into the output latches during that conversion cycle. When this pin is wired directly to the EOC output (pin 14), every conversion will be displayed. When this pin is driven from an external source, the voltage should be referenced to V_{SS}.

CLOCK (Clk I, Clk O, Pins 10, 11)

The MC14433 device contains its own oscillator system clock. A single resistor connected between pins 10 and 11 sets the clock frequency. If increased stability is desired, these pins will support a crystal or LC circuit. The clock input, pin 10, may also be driven from an external clock source which need have only standard CMOS output drive. For external clock inputs this pin is referenced to V_{EE}. A 300 kΩ resistor results in clock frequency of about 66 kHz. (See the typical characteristic curves.) For alternate circuits see Figure 7.

NEGATIVE POWER SUPPLY (V_{EE}, Pin 12)

This is the connection for the most negative power supply voltage. The typical current is 0.8 mA. Note the current for the output drive circuit is not returned through this pin, but through pin 13.

NEGATIVE POWER SUPPLY FOR OUTPUT CIRCUITRY (V_{SS}, Pin 13)

This is the low voltage level for the output pins of the MC14433 (BCD, Digit Selects, EOC, $\overline{OR}$). When this pin is connected to analog ground, the output voltage is from analog ground to V_{DD}. When connected to V_{EE}, the output swing is from V_{EE} to V_{DD}. The allowable operating range for V_{SS} is between $V_{DD} - 3.0$ volts and V_{EE}.

END OF CONVERSION (EOC, Pin 14)

The EOC output produces a pulse at the end of each conversion cycle. This pulse width is equivalent to one half the period of the system clock (pin 11).

OVERRANGE ($\overline{OR}$, Pin 15)

The $\overline{OR}$ pin is low when V_X exceeds V_{ref}. Normally it is high.

DIGIT SELECT (DS4, DS3, DS2, DS1; Pins 16, 17, 18, 19)

The digit select output is high when the respective digit is selected. The most significant digit (½ digit) turns on immediately after an EOC pulse followed by the remaining digits, sequencing from MSD to LSD. An inter-

digit blanking time of two clock periods is included to ensure that the BCD data has settled. The multiplex rate is equal to the clock frequency divided by 80. Thus, with a system clock rate of 66 kHz, the multiplex rate would be 0.8 kHz. Relative timing among digital select ouptut and EOC signals is shown in the Digit Select Timing Diagram, Figure 8.

BCD DATA OUTPUTS (Q3, Q2, Q1, Q0; Pins 20, 21, 22, 23)

Multiplexed BCD outputs contain 3 full digits of information during DS2, 3, 4, while during DS1, the ½ digit, overrange, underrange and polarity are available. The adjacent truth table shows the formats of the information during DS1.

POSITIVE POWER SUPPLY (V_{DD}, Pin 24)

The most positive supply voltage pin.

TRUTH TABLE

Coded Condition of MSD	Q3	Q2	Q1	Q0	BCD to 7 Segment Decoding
+0	1	1	1	0	Blank
−0	1	0	1	0	Blank
+0 UR	1	1	1	1	Blank
−0 UR	1	0	1	1	Blank
+1	0	1	0	0	4 → 1 } Hook up
−1	0	0	0	0	0 → 1 } only seg b
+1 OR	0	1	1	1	7 → 1 } and c to
−1 OR	0	0	1	1	3 → 1 } MSD

Notes for Truth Table

Q3 — ½ digit, low for "1", high for "0"

Q2 — Polarity: "1" = positive, "0" = negative

Q0 — Out of range condition exists if Q0 = 1. When used in conjunction with Q3 the type of out of range condition is indicated, i.e., Q3 = 0 → OR or Q3 = 1 → UR.

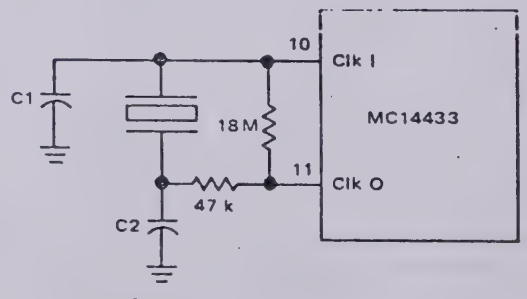
When only segment b and c of the decoder are connected to the ½ digit of the display, 4, 0, 7 and 3 appear as 1.

The overrange indication (Q3 = 0 and Q0 = 1) occurs when the count is greater than 1999, e.g., 1.999 V for a reference of 2.000 V. The underrange indication, useful for autoranging circuits, occurs when the count is less than 180, e.g., 0.180 V for a reference of 2.000 V.

Caution: If the most significant digit is connected to a display other than a "1" only; such as a full digit display, segments other than b and c must be disconnected. The BCD to seven segment decoder must blank on BCD inputs 1010 to 1111.

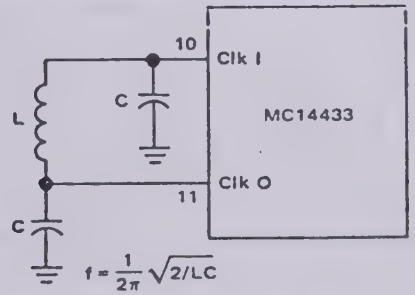
ALTERNATE OSCILLATOR CIRCUITS

(a) Crystal Oscillator Circuit



10 pF < C1 and C2 < 200 pF

(b) LC Oscillator Circuit



$f = \frac{1}{2\pi}\sqrt{2/LC}$

For L = 5 mH and C = 0.01 μF, f ≅ 32 kHz

FIGURE 9 – INTEGRATOR WAVEFORMS AT PIN 6

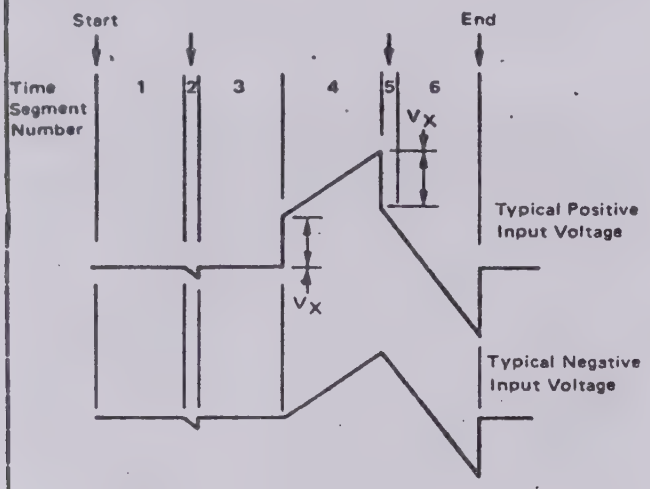
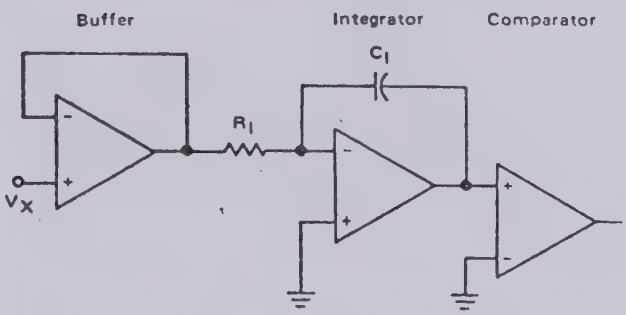


FIGURE 10 – EQUIVALENT CIRCUIT DIAGRAMS OF THE ANALOG SECTION DURING SEGMENT 4 OF THE TIMING CYCLE



CIRCUIT OPERATION

The MC14433 CMOS integrated circuit, together with a minimum number of external components, forms a modified dual ramp A/D converter. The device contains the customary CMOS digital logic providing counters, latches, and multiplexing circuitry as well as the CMOS analog circuitry providing operational amplifiers and comparators required to implement a complete single chip A/D. Autozero, high input impedances, and autopolarity are features of this system. Using CMOS technology, an A/D with a wide range of power supply voltage and low power consumption is now available with the MC14433.

During each conversion, the offset voltages of the internal amplifiers and comparators are compensated for by the system's autozero operation. Also each conversion 'ratiometrically' measures the unknown input voltage. In other words, the output reading is the ratio of the unknown voltage to the reference voltage with a ratio of 1 equal to the maximum count 1999. The entire conversion cycle requires slightly more than 16000 clock periods and may be divided into six different segments. The waveforms showing the conversion cycle with a positive input and a negative input are shown in Figure 9. The six segments of these waveforms are described below.

Segment 1 – The offset capacitor (C_O), which compensates for the input offset voltages of the buffer and integrator amplifiers, is charged during this period. Also, the integrator capacitor is shorted. This segment requires 4000 clock periods.

Segment 2 – The integrator output decreases to the comparator threshold voltage. At this time a number of counts equivalent to the input offset voltage of the comparator is stored in the offset latches for later use in the autozero process. The time for this segment is variable, and less than 800 clock periods.

Segment 3 – This segment of the conversion cycle is the same as Segment 1.

Segment 4 – Segment 4 is an up-going ramp cycle with the unknown input voltage (V_X) as the input to the integrator. Figure 10 shows the equivalent configuration of the analog section of the MC14433. The actual configuration of the analog section is dependent upon the polarity of the input voltage during the previous conversion cycle.

Segment 5 – This segment is a down-going ramp period with the reference voltage as the input to the integrator. Segment 5 of the conversion cycle has a time equal to the number of counts stored in the offset storage latches during Segment 2. As a result, the system zeros automatically.

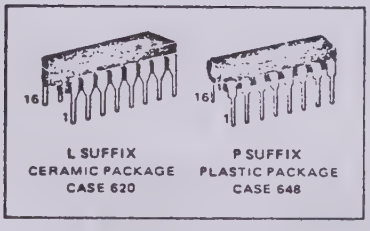
Segment 6 – This is an extension of Segment 5. The time period for this portion is 4000 clock periods. The results of the A/D conversion cycle are determined in this portion of the conversion cycle.

CMOS DUAL BCD UP COUNTER

DUAL UP COUNTERS

The MC14518 dual BCD counter and the MC14520 dual binary counter are constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic structure. Each consists of two identical, independent, internally synchronous 4-stage counters. The counter stages are type D flip-flops, with interchangeable Clock and Enable lines for incrementing on either the positive-going or negative-going transition as required when cascading multiple stages. Each counter can be cleared by applying a high level on the Reset line. In addition, the MC14518 will count out of all undefined states within two clock periods. These complementary MOS up counters find primary use in multi-stage synchronous or ripple counting applications requiring low power dissipation and/or high noise immunity.

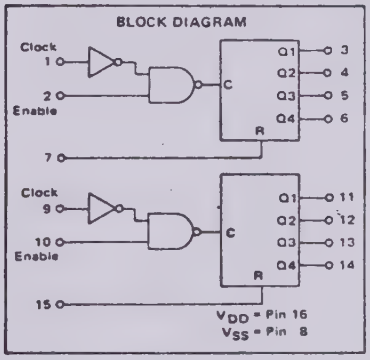
DUAL BCD UP COUNTER
(MC14518)
DUAL BINARY UP COUNTER
(MC14520)



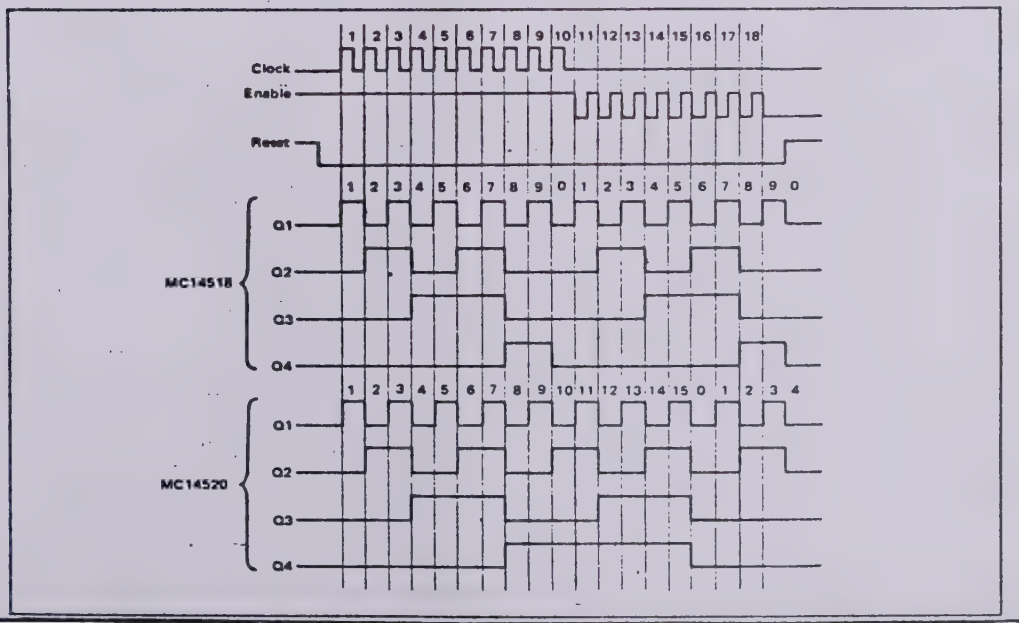
TRUTH TABLE

CLOCK	ENABLE	RESET	ACTION
⌐	1	0	Increment Counter
0	⌐	0	Increment Counter
¬	X	0	No Change
X	¬	0	No Change
⌐	0	0	No Change
1	¬	0	No Change
X	X	1	Q1 thru Q4 = 0

X = Don't Care



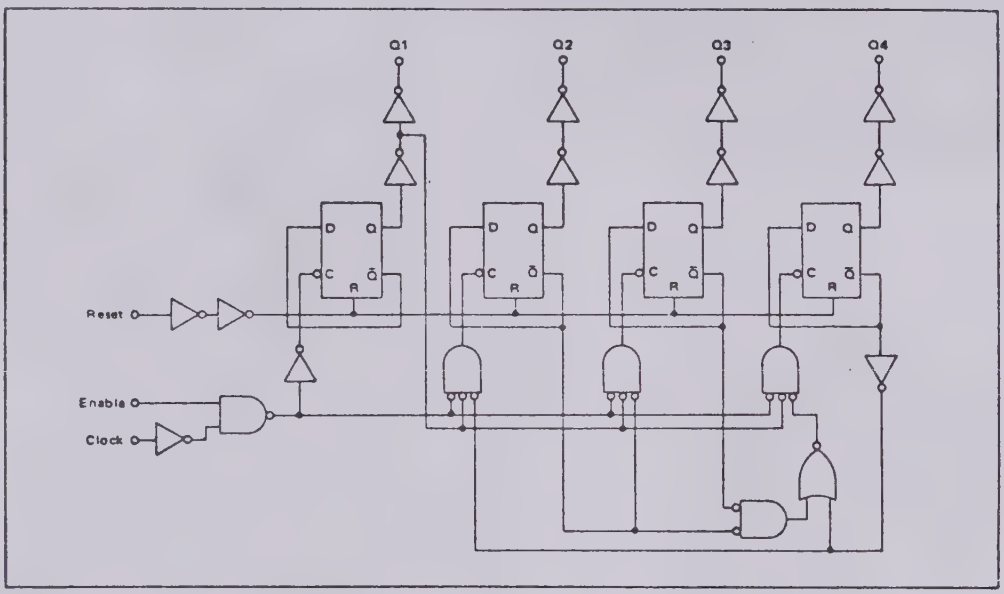
TIMING DIAGRAM



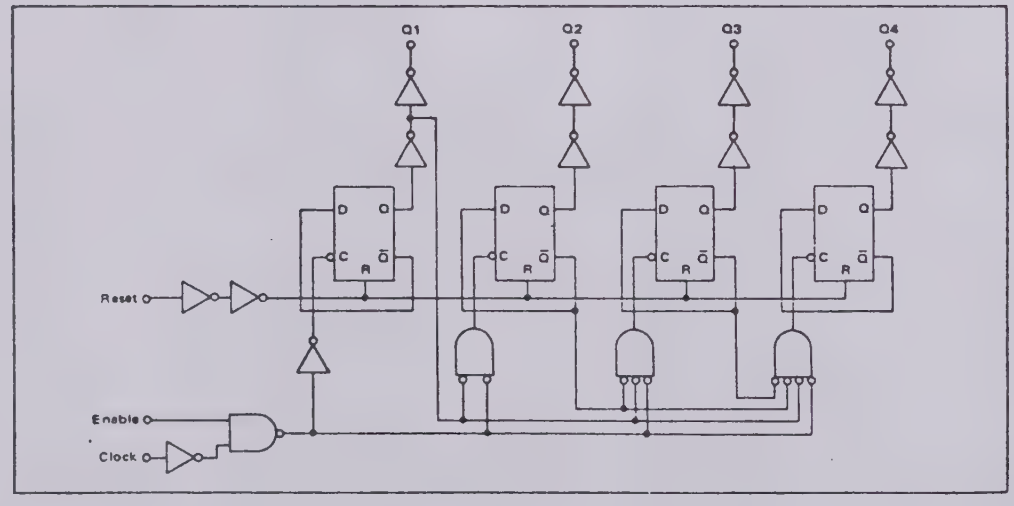
MC14518CP
MC14520CP

S-D P/N 103339
S-D P/N 117278

DECADE COUNTER (MC14518) LOGIC DIAGRAM
(1/2 OF DEVICE SHOWN)



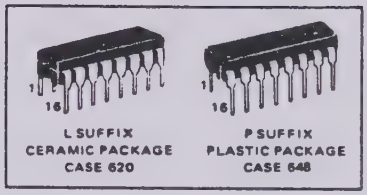
BINARY COUNTER (MC14520) LOGIC DIAGRAM
(1/2 OF DEVICE SHOWN)

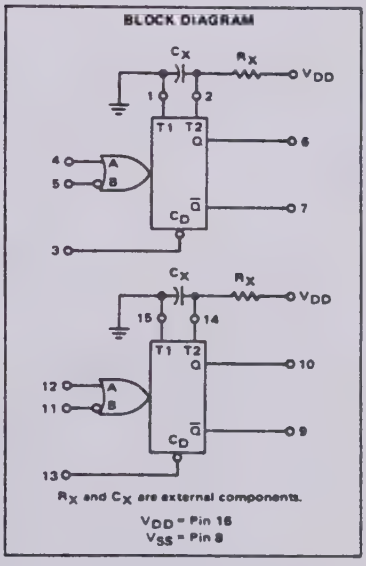


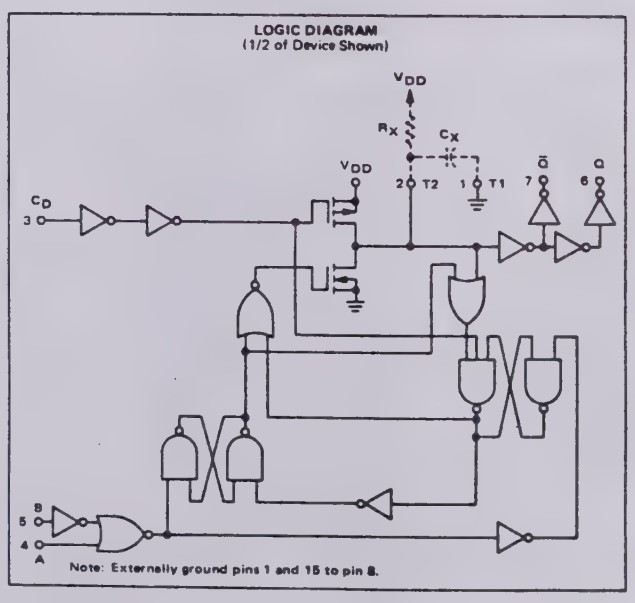
MC14528AL
MC14528CL
MC14528CP

DUAL MONOSTABLE MULTIVIBRATOR

The MC14528 is a dual, retriggerable, resettable monostable multivibrator. It may be triggered from either edge of an input pulse, and will produce an accurate output pulse over a wide range of widths, the duration and accuracy of which are determined by the external timing components, C_X and R_X.







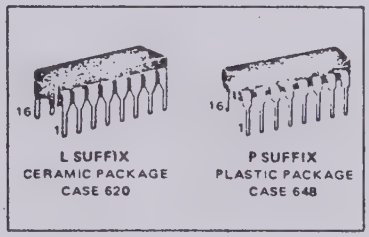
MC14560 S-D P/N 103433

NBCD ADDER

The MC14560 adds two 4-bit numbers in NBCD (natural binary coded decimal) format, resulting in sum and carry outputs in NBCD code.

This device can also subtract when one set of inputs is complemented with a 9's Complementer (MC14561).

All inputs and outputs are active high. The carry input for the least significant digit is connected to V_{SS} for no carry in.

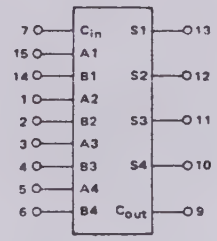


TRUTH TABLE*

INPUT									OUTPUT				
A4	A3	A2	A1	B4	B3	B2	B1	C_{in}	C_{out}	S4	S3	S2	S1
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	0	0	0	0	1
0	1	0	0	0	0	1	1	0	0	0	1	1	1
0	1	0	0	0	0	1	1	1	0	1	0	0	0
0	1	1	1	0	1	0	0	0	1	0	0	0	1
0	1	1	1	0	1	0	0	1	1	0	0	1	0
1	0	0	0	0	1	0	1	0	1	0	0	1	1
0	1	1	0	1	0	0	0	0	1	0	1	0	0
1	0	0	1	1	0	0	1	1	1	1	0	0	1

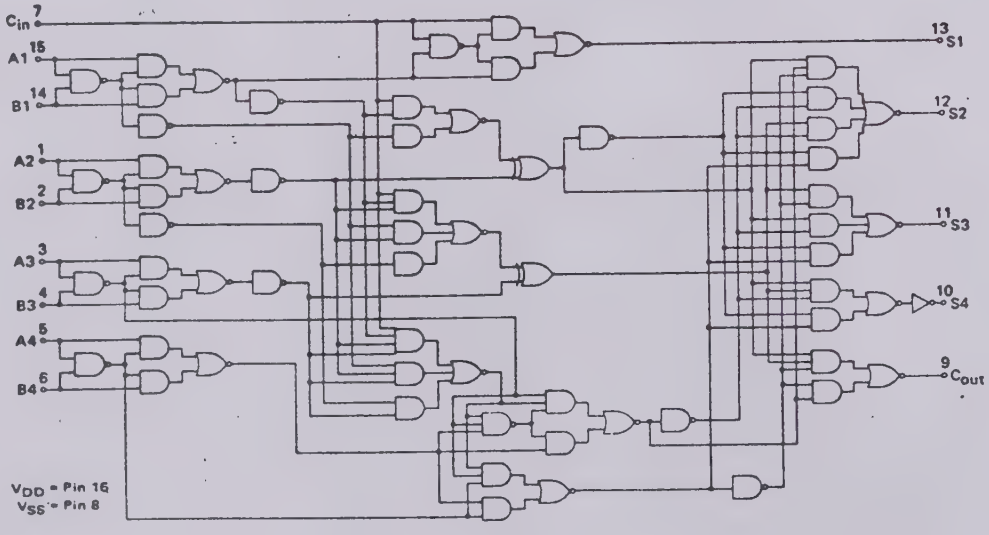
*Partial truth table to show logic operation for representative input values.

BLOCK DIAGRAM



V_{DD} = Pin 16
V_{SS} = Pin 8

FUNCTIONAL EQUIVALENT LOGIC DIAGRAM



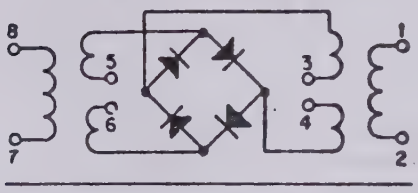
SAM-1

S-D P/N 102911

PIN CONNECTIONS

	SAM-1 * SAM-2 SAM-3
LO	8
RF	1
IF	3,4
Ground	2,5,6,7
Case ground	2

NOTE: PINS 3 AND 4 MUST BE CONNECTED TOGETHER



ABSOLUTE MAXIMUM RATINGS

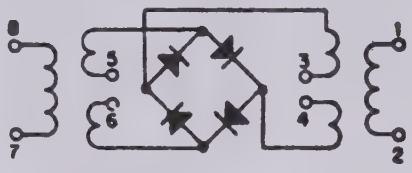
Total Input Power	50mW
Total Input, Current Peak	40mA
Operating & Storage Temperature	−55° C to +100° C
Pin Temperature (10 seconds)	510° F

		MODEL SAM-1	
Frequency Range, MHz	LO	1-600	
	RF	1-600	
	IF	DC-600	
Conversion Loss, dB		Typical	Maximum
One Octave From Band Edge		5.5	7.0
Total Range		6.5	8.5
Signal, 1dB Compression Level		+1dBm	
Isolation, dB		Typical	Minimum
Lower Band Edge to One Decade Higher	LO-RF	55	45
	LO-IF	50	40
Mid Range	LO-RF	45	30
	LO-IF	40	25
Upper Band Edge to One Octave Lower	LO-RF	35	20
	LO-IF	30	20
Impedance, All Ports		50 ohms	
Phase Detection			
DC Offset		1mV typical	
DC Polarity		Negative	
Electronic Attenuation			
Minimum Attenuation (20mA)		3.5dB	

PIN CONNECTIONS

	SAM-1 * SAM-2 SAM-3
LO	8
RF	1
IF	3,4
Ground	2,5,6,7
Case ground	2

NOTE: PINS 3 AND 4 MUST BE CONNECTED TOGETHER



ABSOLUTE MAXIMUM RATINGS

Total Input Power	50mW
Total Input, Current Peak	40mA
Operating & Storage Temperature	−55° C to +100° C

Pin Temperature (10 seconds) 510° F

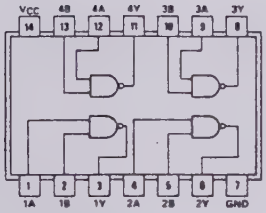
		MODEL-SAM-2	
Frequency Range, MHz	LO	1-1000	
	RF	1-1000	
	IF	DC-1000	
		Typical	Maximum
Conversion Loss, dB One Octave From Band Edge		6	7.5
Total Range		7.0	9.5
Signal, 1dB Compression Level		+1dBm	
		Typical	Minimum
Isolation, dB		55	45
Lower Band Edge to One Decade Higher	LO-RF	50	40
	LO-IF	40	25
Mid Range	LO-RF	40	25
	LO-IF	35	20
Upper Band Edge to One Octave Lower	LO-RF	30	20
	LO-IF		
Impedance, All Ports		50 ohms	
Phase Detection		1mV typical	
DC Offset		Negative	
DC Polarity			
Electronic Attenuation Minimum Attenuation (20mA)		3.5dB	

TTL LOW POWER SCHOTTKY QUAD 2-INPUT NAND GATES

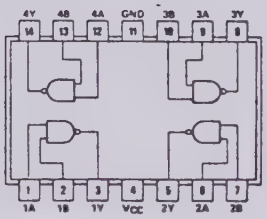
SN7400N
SN74L00N
SN74LS00N
SN74S00N

S-D P/N 019705
S-D P/N 025796
S-D P/N 103130
S-D P/N 025785

positive logic:
$Y = \overline{AB}$



SN5400/SN7400(J, N)
SN54H00/SN74H00(J, N)
SN54L00/SN74L00(J, N)
SN54LS00/SN74LS00(J, N, W)
SN54S00/SN74S00(J, N, W)



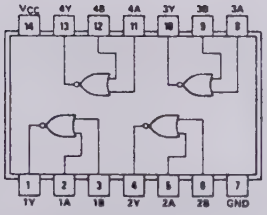
SN5400/SN7400(W)
SN54H00/SN74H00(W)
SN54L00/SN74L00(T)

QUADRUPLE 2-INPUT POSITIVE-NOR GATES

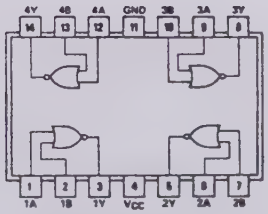
SN7402N
SN74L02N
SN74LS02N

S-D P/N 025709
S-D P/N 025797
S-D P/N 103367

positive logic:
$Y = \overline{A+B}$



SN5402/SN7402(J, N)
SN54L02/SN74L02(J, N)
SN54LS02/SN74LS02(J, N, W)
SN54S02/SN74S02(J, N, W)

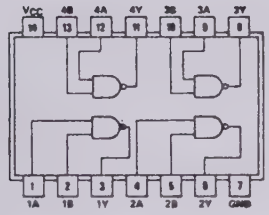


SN5402/SN7402(W)
SN54L02/SN74L02(T)

QUADRUPLE 2-INPUT POSITIVE-NAND GATES WITH OPEN-COLLECTOR OUTPUTS

SN7403N — S-D P/N 103218
SN74L03N — S- D P/N 045217

positive logic:
$Y = \overline{AB}$

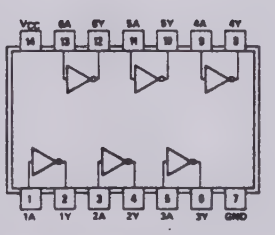


SN5403/SN7403(J, N)
SN54L03/SN74L03(J, N)
SN54LS03/SN74LS03(J, N, W)
SN54S03/SN74S03(J, N, W)

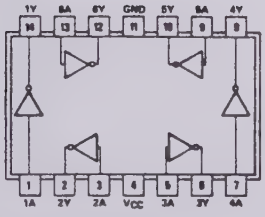
HEX INVERTERS

SN74H04N — S-D P/N 106635
SN74L04N — S-D P/N 045204
SN74LS04N — S-D P/N 103749

positive logic:
$Y = \overline{A}$



SN5404/SN7404(J, N)
SN54H04/SN74H04(J, N)
SN54L04/SN74L04(J, N)
SN54LS04/SN74LS04(J, N, W)
SN54S04/SN74S04(J, N, W)

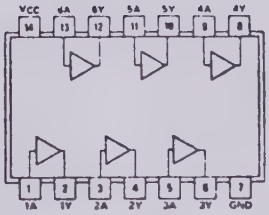


SN5404/SN7404(W)
SN54H04/SN74H04(W)
SN54L04/SN74L04(T)

HEX BUFFERS/DRIVERS WITH OPEN-COLLECTOR HIGH VOLTAGE OUTPUTS

SN7407N — S-D P/N 045295

positive logic:
Y = A

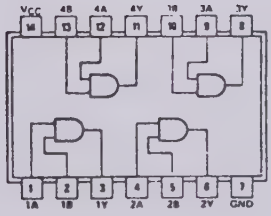


SN5407/SN7407(J, N, W)

TTL LOW POWER SCHOTTKY QUAD 2-INPUT AND GATES

SN7408N — S-D P/N 103093
SN74LS08N — S-D P/N 103967
SN74S08N — S-D P/N 117058

positive logic:
Y = AB



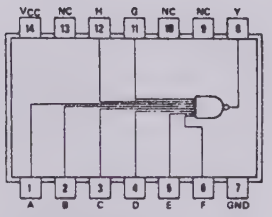
SN5408/SN7408(J, N, W)
SN54LS08/SN74LS08(J, N, W)

TTL LOW POWER SCHOTTKY 8-INPUT NAND GATE

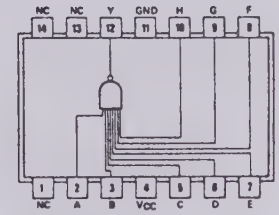
SN7430N
SN74LS30N

S-D P/N 025726
S-D P/N 103971

positive logic:
$Y = \overline{ABCDEFGH}$



SN5430/SN7430(J, N)
SN54H30/SN74H30(J, N)
SN54L30/SN74L30(J, N)
SN54LS30/SN74LS30(J, N, W)
SN54S30/SN74S30(J, N, W)



SN5430/SN7430(W)
SN54H30/SN74H30(W)
SN54L30/SN74L30(T)

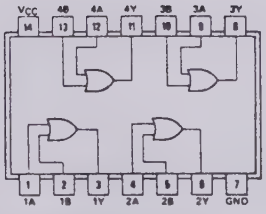
NC—No internal connection

TTL QUAD 2-INPUT OR GATE

SN7432N
SN74LS32N
SN74S32N

S-D P/N 045257
S-D P/N 103972
S-D P/N 103973

positive logic:
Y = A+B

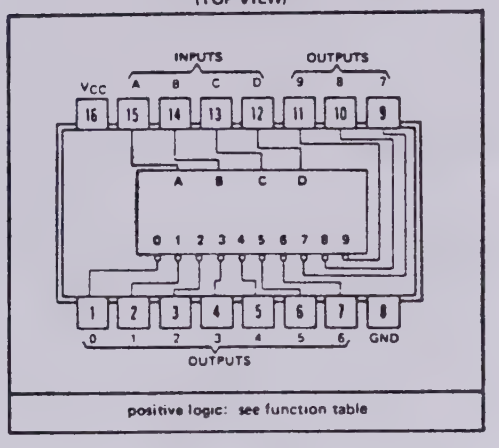


SN5432/SN7432(J, N, W)
SN54LS32/SN74LS32(J, N, W)

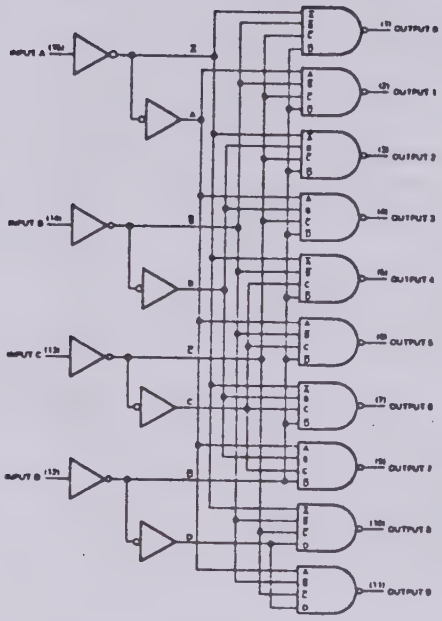
SN7442N

S-D P/N 025749

(TOP VIEW)



positive logic: see function table



'42A, 'L42
BCD-TO-DECIMAL DECODERS

NO.	'42A, 'L42 BCD INPUT			
	D	C	B	A
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H
INVALID	H	L	H	L
	H	L	H	H
	H	H	L	L
	H	H	L	H
	H	H	H	L
	H	H	H	H

ALL TYPES DECIMAL OUTPUT									
0	1	2	3	4	5	6	7	8	9
L	H	H	H	H	H	H	H	H	H
H	L	H	H	H	H	H	H	H	H
H	H	L	H	H	H	H	H	H	H
H	H	H	L	H	H	H	H	H	H
H	H	H	H	L	H	H	H	H	H
H	H	H	H	H	L	H	H	H	H
H	H	H	H	H	H	L	H	H	H
H	H	H	H	H	H	H	L	H	H
H	H	H	H	H	H	H	H	L	H
H	H	H	H	H	H	H	H	H	L
H	H	H	H	H	H	H	H	H	H
H	H	H	H	H	H	H	H	H	H
H	H	H	H	H	H	H	H	H	H
H	H	H	H	H	H	H	H	H	H
H	H	H	H	H	H	H	H	H	H
H	H	H	H	H	H	H	H	H	H

SN74L75 S-D P/N 045201

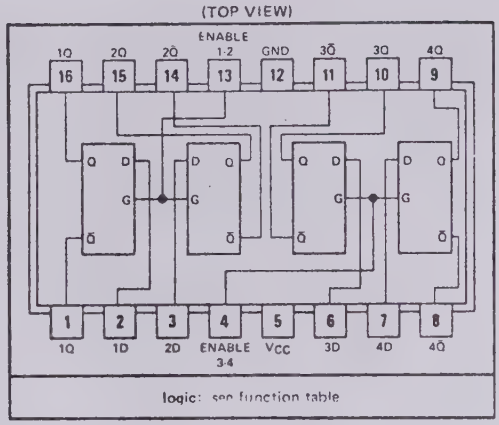
description

These latches are ideally suited for use as temporary storage for binary information between processing units and input/output or indicator units. Information present at a data (D) input is transferred to the Q output when the enable (G) is high and the Q output will follow the data input as long as the enable remains high. When the enable goes low, the information (that was present at the data input at the time the transition occurred) is retained at the Q output until the enable is permitted to go high.

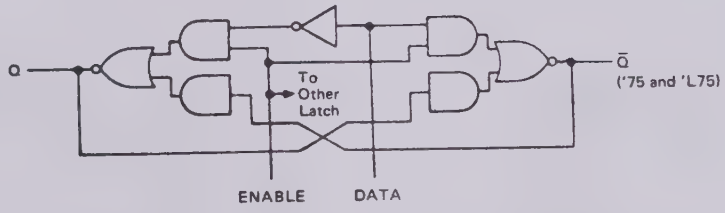
The '75 and 'L75 feature complementary Q and $\overline{Q}$ outputs from a 4-bit latch, and are available in various 16-pin packages. For higher component density applications, the '77 and 'L77 4-bit latches are available in 14-pin flat packages.

These circuits are completely compatible with all popular TTL or DTL families. All outputs are diode-clamped to minimize transmission-line effects and simplify system design. Series 54 and 54L devices are characterized for operation over the full military temperature range of −55°C to 125°C; Series 74 and 74L devices are characterized for operation from 0°C to 70°C.

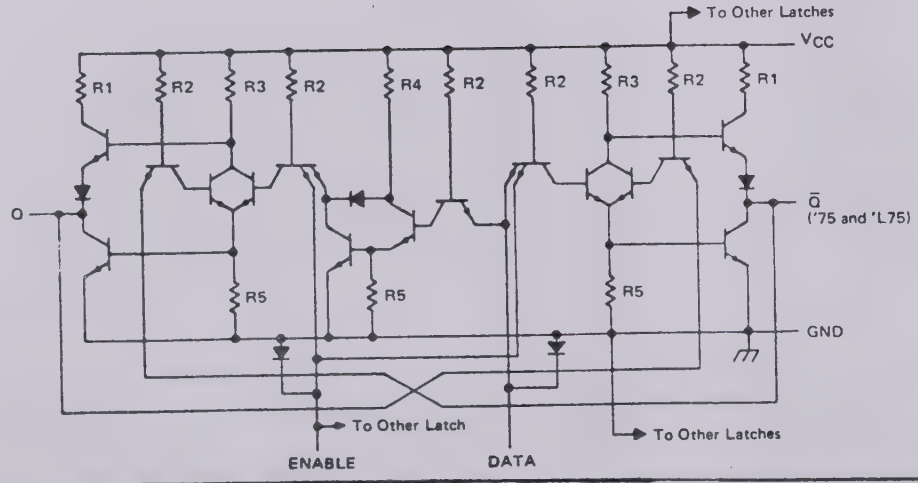
'75 . . . J, N, OR W PACKAGE
'L75 . . . J OR N PACKAGE
(TOP VIEW)



functional block diagram (each latch)



schematic (each latch)



NOMINAL RESISTOR VALUES

RESISTOR	'75, '77	'L75, 'L77
R1	130 Ω	260 Ω
R2	4 kΩ	8 kΩ
R3	1.6 kΩ	3.2 kΩ
R4	2.5 kΩ	5 kΩ
R5	1 kΩ	2 kΩ

ECL DIVIDE-BY-10/11 COUNTER

11C90 **S-D P/N 103416**

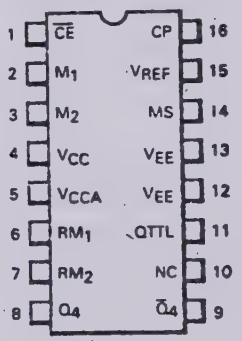
GENERAL DESCRIPTION – The 11C90 is a high speed prescaler designed specifically for communication and instrumentation applications. It will divide by either 10 or 11 over a frequency range from dc to typically 650 MHz. The division ratio is controlled by the mode control. The divide by 10 or 11 capability allows the use of pulse swallowing techniques to control high speed counting modulos by lower speed circuits. The 11C90 may be used with either ECL or TTL power supplies.

In addition to the ECL outputs $\overline{Q}_4$ and Q_4, the 11C90 contains an ECL-to-TTL converter and a TTL output. The TTL output operates from the same V_{CC} and V_{EE} levels as the counter, but a separate pin is used for the TTL circuit V_{EE}. This minimizes noise coupling when the TTL output switches and also allows power consumption to be reduced by leaving the separate V_{EE} pin open if the TTL output is not used.

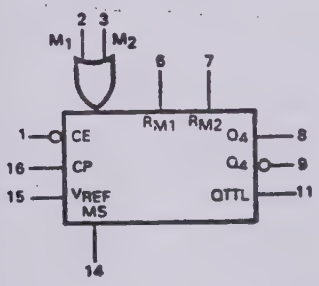
To facilitate capacitive coupling of the clock signal, a 400 Ω resistor (V_{REF}) is connected internally to the V_{BB} reference. Connecting this resistor to the Clock Pulse input (CP) automatically centers the input signal about the switching threshold. Maximum frequency operation is achieved with a 50% duty cycle.

Each of the Mode Control inputs is connected to an internal 2 k resistor with the other end uncommitted (RM_1 and RM_2). An M input can be driven from a TTL circuit operating from the same V_{CC} by connecting the free end of the associated 2 k resistor to V_{CCA}. When an M input is driven from an ECL circuit, the 2 k resistor can be left open or, if required, can be connected to V_{EE} to act as a pull-down resistor. The device is packaged in a hermetic 16-pin ceramic Dual In-line package. It is available in commercial and military temperature ranges.

CONNECTION DIAGRAM
DIP (TOP VIEW)

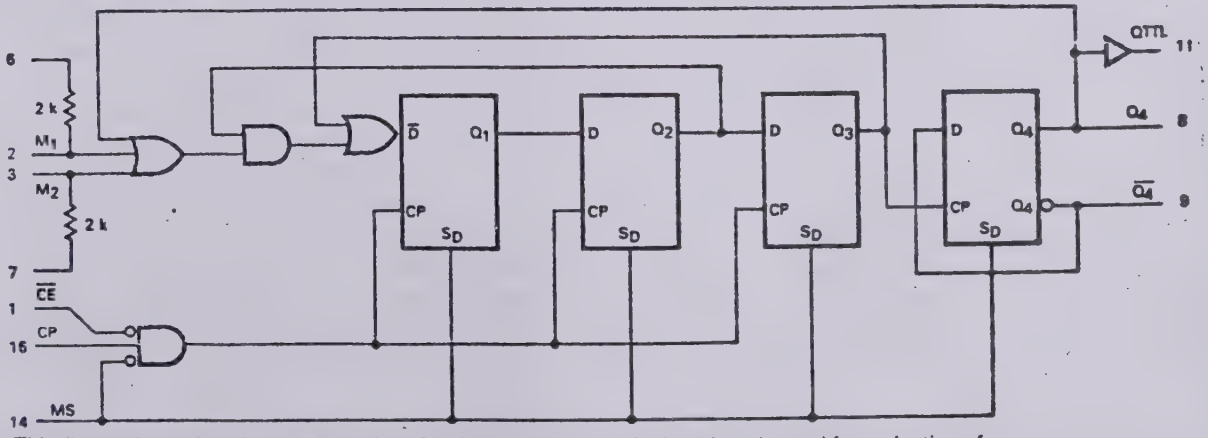


LOGIC SYMBOL



V_{CC} = Pin 4
V_{CCA} = Pin 5
V_{EE} = Pin 12
V_{EE} (TTL) = Pin 13

LOGIC DIAGRAM



Note: This diagram is provided for understanding of logic operation only. It should not be used for evaluation of propagation delays as many internal functions are achieved more efficiently then shown.

CHAPTER 6

REPLACEABLE PARTS LISTS

6.1 INTRODUCTION

This chapter contains the replaceable parts lists for each of the assemblies in the Model R-1201A Signal Generator. Table 6-1 provides a listing of the assembly, part number and page number.

TABLE 6-1 PARTS LISTS LOCATION

TITLE	MOTOROLA PART NO.	PAGE
Shipping Assembly	R-1201A	6-2
Test Assembly	RTX-4004A	6-3
Power Supply Sub-Assembly		6-5
Front Panel Assembly	1-80307A39	6-6
A1, Power Supply Regulator Assembly	1-80307A18	6-7
A1A1, +5V Regulator PC Assembly	1-80307A19	6-8
A1A2, -5V Regulator PC Assembly	1-80307A20	6-9
A2, Rectifier PC Assembly	1-80307A21	6-10
A3, Motherboard PC Assembly	1-80307A22	6-11
A3A1, Switch PC Assembly	1-80307A23	6-13
A3A2, Display PC Assembly	1-80307A24	6-14
A3A3, Mod Control PC Assembly	1-80307A25	6-16
A4, Synthesizer Assembly	1-80307A30	6-19
A4A1, AC Discriminator PC Assembly	1-82778K15	6-20
A4A2, 10 MHz VCO PC Assembly	1-82778K17	6-22
A4A3, DC Discriminator PC Assembly	1-82822K93	6-26
A4A4, Time Base PC Assembly	1-82822K92	6-29
A4A5, Source 2 PC Assembly	1-82822K87	6-31
A4A6, Source 3 PC Assembly	1-82822K88	6-33
A4A8, 400 MHz Reference PC Assembly	1-82778K18	6-37
A4A9, Logic PC Assembly	1-82778K20	6-40
A4A10, Divide-By-N PC Assembly	1-82778K19	6-42
A4A11, Source 4 PC Assembly	1-82822K89	6-44
A4A12, Phase Detector PC Assembly	1-82822K94	6-47
A4A13, Source 5 PC Assembly	1-80307A65	6-50
A4A14, Amplifier PC Assembly	1-82822K91	6-55
A4A15, Motherboard PC Assembly	1-82778K28	6-59
A4A16, Mixer PC Assembly	1-82822K98	6-61
A4A17, Connector PC Assembly	1-82778K29	6-62
A4A18, L.O. Switch PC Assembly	1-80306A45	6-63
Clock Oscillator Chassis Assembly	1-80307A27	6-65
A5, Oscillator Control PC Assembly	1-80307A28	6-65
Clock Oscillator Chassis Assembly Opt. 01	1-80307A92	6-67
A5, Oscillator Control PC Assembly Opt. 01	1-80307A93	6-68
Clock Oscillator Chassis Assembly Opt. 02	1-80307A95	6-70
A5, Oscillator Control PC Assembly Opt. 02	1-80307A96	6-71

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION: MODEL R-1201A SHIPPING ASSEMBLY

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
	Shipping Assembly (Rev C)	R-1201A	057716	1
	Test Assembly	RTX-4004A	057586	1
	Decorative Panel	64-80332A13	057528	1
	Bottom Cover Assembly	1-80307A32	067310	1
	Top Cover	15-80329A81	03376005	1
	Side Cover	15-80329A82	03356505	2
	Handle	55-80313A30	03357005	2
	Rear End Block	7-80329A83	03903401	2
	Front End Block	7-80329A84	03367401	2
	Front Trim	7-80329A85	033762	2
	Side Trim	7-80329A86	03985905	2
	Window	61-80329A89	057538	1
	Mtg. Bracket Cover	1-80307A29	039857	2
	Trim Strip	7-80329A87	057536	1
	Trim Strip Insert	7-80329A88	057537	1
	Side Trim Bottom Rail	7-80330A97	067308	2
	Knob Shirt	36-80329A90	117217	2
	Knob	36-80329A91	106857	2
	Extender Board	1-80307A29	057102	1
	Line Cord	30-82393K01	102407	

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION: TEST ASSEMBLY #RTX-4004A

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
	Test Assembly (Rev E)	RTX-4004A	057586	REF
1	Assembly, Synthesizer, A4	1-80307A30	057436	1
2	Power Supply Sub-Assembly		057559	1
3	Power Supply Regulator Assembly, A1	1-80307A18	057646	1
4	Clock Oscillator, Chassis Assembly,A5	1-80307A27	057560	1
5	Front Panel Assembly	1-80307A39	057585	1
6	Mother Board PC Assembly, A3	1-80307A22	05790001	1
7	Mod Control PC Assembly, A3A3	1-80307A25	05788201	1
8	Switch PC Assembly, A3A1	1-80307A23	05754101	1
9	Display PC Assembly, A3A2	1-80307A24	05754401	1
10	Pushbutton Switch Assembly, A3S1	1-80307A26	057516	1
11	RF Attenuator, U1	1-82778K34	053994	1
12	Line Filter Assembly W/AC Receptical	1-84209D40	102461	1
13	Fuse Post	9-82083C02	102409	1
14	Fuse Slo-Blo 1.5A	65-890033	100591	1
15	Right Gusset & Rear Panel		057709	1
16	Left Gusset & Rear Panel		057527	1
17	Center Brace		057521	1
18	Heatsink	7-80332A16	057905	1
19	Screw, PHMS 2-56 x 1/4	3-80312A78	10062504	2
20	Screw, PHMS 4-40 x 7/16	3-80311A59	10062607	4
21	Screw, PHMS 6-32 x 1/4	3-80311A26	10063204	6
22	Screw, PHMS 6-32 x 5/16	3-80311A23	10063205	20
23	Screw, PHMS 6-32 x 3/8	3-80311A24	10063206	6
24	Screw, PHMS 6-32 x 7/16	3-80311A61	10063207	18
25	Screw, PHMS 6-32 x 5/8	3-80332A23	10063210	1
26	Screw, PHMS 8-32 x 3/8	3-80329A69	10064206	6
27	Washer, Flat #2	4-80311A76	100614	2
28	Washer, Flat #4	4-7607	100703	8
29	Washer, Flat #6	4-1720	100704	11
30	Washer, Split #2	4-400139	100661	2
31	Washer, Split #4	4-114583	100711	7
32	Washer, Split #6	4-7669	100712	42
33	Washer, Split #8	2-7041	100636	2
34	Nut, #2	2-7041	100636	2
35	Nut, #4	7-7019	100707	6
36	Lug, #4	29-80332A21	100509	1
37	Spacer, #6	43-80332A17	100691	1
38	Cable Clamp 3/8	42-82143C08	100718	1
39	Bracket	7-80311A40	100849	2
41	Screw, PHMS 6-32 x 1/4	3-80311A26	10063204	2

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION: TEST ASSEMBLY #RTX-4004A (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S–D PART NO.	QTY PER ASSY
42	Screw, PHMS 4-40 x 7/16	3-80311A59	10062607	2
43	Screw, FHMS 8-32 x 1/4	3-80311A99	10074304	2
44	Plug, AC Line Select 115V, J7	1-80307A34	05767802	1
45	Assembly, Semi-Rigid Cable	1-80306A39	055682	1
46	RF Connector, N to SMA	9-80330A96	101135	1
47	Nut, KEP #4-40	2-80311A16	100941	4
48	Plate, Cover 24-pin	64-80330A89	03141811	1
49	Plug, Bottom (On Rear Panel)	38-80330A93	100840	2
50	Plug, Bottom (On Rear Panel)	38-80330A94	112644	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION: POWER SUPPLY SUB-ASSEMBLY

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
	Power Supply Sub-Assembly (Rev C)		057559	REF
	Chassis, Power Supply		057526	1
T1	Transformer, Power	25-80332A05	057626	1
3	Grommet	5-80329A79	103003	1
4	Grommet, Caterpiller	5-80330A98	100913	A/R
C1,C2	Capacitor, Electrolytic 30,000 µF, 15V	23-80321A33	103188	2
6	Clamp, 2" ID Capacitor	42-82778K57	106879	2
C4,C5	Capacitor, Electrolytic 4600 µF, 40V	23-80321A34	103189	2
8	Clamp, 1-3/8" ID Capacitor	42-82778K70	100725	3
C3	Capacitor, Electrolytic 1800 µF, 50V	23-80329A93	103063	1
XA1	Connector, 22-pin	28-80329A92	102637	1
A2	Assembly, PC Rectifier	1-80307A21	05760601	1
13	Screw, PHMS 4-40 x 1/2	3-80329A68	10062608	2
14	Washer, Flat #4	4-7607	100703	2
15	Nut, Nylock #4-40	2-875032	100715	2
16	Screw, PHMS 6-32 x 1/2	3-80311A19	10063208	6
17	Washer, Flat #6	4-1720	100704	18
18	Nut, #6-32	2-80311A17	100862	13
19	Screw, PHMS 10-32 x 1/4	3-80329A74	10064404	10
20	Lug, Solder #10	29-80329A76	100989	10
21	Screw, PHMS 6-32 x 5/16	3-80311A23	10063205	11
22	Washer, Split #6	4-7660	100712	4
23	Clamp, 3/8	42-82143C08	100718	1
25	Screw, PHMS 8-32 x 3/8	3-80329A69	10064206	5
26	Washer, Flat #8	4-7562	100705	1
27	Washer, Split #8	4-7671	100713	6
28	Screw, PHMS 8-32 x 1/2	3-80329A70	10064208	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION MODEL R-1201A FRONT PANEL ASSEMBLY #1-80307A39

REF. #	DESCRIPTION	MOTOROLA PART NO.	S–D PART NO.	QTY PER ASSY
	ASSEMBLY, Front Panel (Rev C)	1-80307A39	057585	REF
1	ASSEMBLY, Sub-Panel Front		057523	1
2	RESISTOR, Variable 500Ω (R2 & R3)	18-80329A94	117294	2
3	RESISTOR, Variable 1 k (R1)	18-80321A19	103419	1
4	SWITCH, Slide DT 3-pos (S1)	40-80329A95	102348	1
5	SWITCH, W/LED (S2)	40-80330A83	117221	1
6	CONNECTOR, BNC (J2 & J3)	9-84205D81	101170	2
8	NUT, Dress 1/3 x 32	2-119518	100920	1
10	LUG, BNC	29-89601A01	107077	2
11	WASHER, Split #4	4-114583	100711	2
12	NUT, 4-40 x 3/16	2-80311A70	100622	2
	FRONT PANEL SUB-ASSEMBLY		057523	REF
	NUT, Press 8-32		100919	10
	NUT, Press 4-40		103067	6
	NUT, Press 2-56		102885	4
	STUD, 4-40 x 3/8	43-80329A78	103395	10
	RIVET	5-1628	100653	3
	BRACKET, Left	7-80311A40	100849	3
	SPACER	43-80332A18	103881	2

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A1, POWER SUPPLY REGULATOR ASSEMBLY #1-80307A18

REF. #	DESCRIPTION	MOTOROLA PART NO.	S–D PART NO.	QTY PER ASSY
A1	ASSEMBLY, Power Supply Reg. (Rev C)	1-80307A18	05764601	REF
Q1	TRANSISTOR, PNP Silicon 2N6040	48-80332A10	103332	1
Q2	TRANSISTOR, PNP Silicon 2N4918	48-84302A70	101387	1
Q3	TRANSISTOR, NPN Silicon 2N6043	48-80321A08	103333	1
Q4	TRANSISTOR, NPN Silicon 2N4921	48-84204D13	101386	1
U1	INTEGRATED CIRCUIT MC7815CP Voltage Regulator +15V	51-84320A82	103039	1
U2	INTEGRATED CIRCUIT, MC7805CP Voltage Regulator +5V	51-84320A47	045256	2
U3	Same as U2			
U4	INTEGRATED CIRCUIT, µA7824UC Voltage Regulator +24V	51-83819K42	045246	1
U5	INTEGRATED CIRCUIT, MC7915 Voltage Regulator -15V	51-84320A81	103040	1
U6	INTEGRATED CIRCUIT, MC7905.2 Voltage Regulator -5.2V	51-84320A72	103033	1
A1A1	ASSEMBLY, +5V Regulator PC	1-80307A17	05753501	1
A1A2	ASSEMBLY, -5.2V Regulator PC	1-80307A20	05753502	1
13	GROMMET, Caterpillar		100913	1
14	INSULATOR, Mica P/O Q1,3,U5,6	14-865875	103352	4
15	WASHER, Nylon Shoulder P/O Q1,3,U5,6	14-857512	103397	4
17	WASHER,#4 P/O Q2,4	4-80332A19	103351	2
18	WASHER, Split #4	4-114583	100711	9
20	WASHER, Split #6	4-7669	100712	4
21	WASHER, Mica	4-80332A20	112371	2
16	SCREW, PHMS 4-40 x 3/8	3-80311A22	10062606	11
19	SCREW, PHMS 6-32 x 5/8	3-80332A23	10063210	4
	BOARD, PC		057646	1
1	HEATSINK		057522	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A1A1, +5V REGULATOR PC ASSEMBLY #1-80307A19

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
A1A1	ASSEMBLY, +5V Regulator PC (Rev B)	1-80307A19	05753501	REF
C1-5	Not Used			
C6	CAPACITOR, Elect, 100 µF, 25V	23-82683B04	100165	1
C7	CAPACITOR, Tant, 1 µF 10%, 35V	23-82783B26	100082	3
C8	Same as C7			
C9	CAPACITOR, Tant, 10 µF 10%, 20V	23-82783B27	100063	2
C10	Same as C7			
C11	Same as C9			
R1	RESISTOR, WW, 2 Ω 5%, 2W	6-185A65	101772	1
R2	RESISTOR, WW, .51 Ω 2W	17-80321A44	103413	1
	SPACER, 4-40 x 3/8	43-80329A78	100973	1
	BOARD, PC		057535	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A1A2, -5.2V REGULATOR PC ASSEMBLY #1-80307A20

REF. #	DESCRIPTION	MOTOROLA PART NO.	S–D PART NO.	QTY PER ASSY
A1A2	ASSEMBLY, -5.2V REGULATOR PC (Rev B)	1-80307A20	05753502	REF
C1-11	Not Used			
C12	CAPACITOR, Elect, 100 µF, 25V	23-82683B04	100165	1
C13	CAPACITOR, Tant, 1 µF 10%, 50V	23-82783B10	103275	3
C14	Same as C13			
C15	CAPACITOR, Tant, 6.8 µF 10%, 35V	23-84677D12	100182	1
C16	Same as C13			
C17	CAPACITOR, Tant, 10 µF 10%, 20V	23-82788B27	100063	1
R1-2	Not Used			
R3	RESISTOR, WW, 2 Ω 5%, 2W	6-185A65	101772	1
R4	RESISTOR, WW, .51 Ω 2W	17-80321A44	103413	1
	SPACER, 4-40 x 3/8	43-80329A78	100973	1
	BOARD, PC		057535	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A2. RECTIFIER PC ASSEMBLY #1-80307A21

REF. #	DESCRIPTION	MOTOROLA PART NO.	S–D PART NO.	QTY PER ASSY
A2	ASSEMBLY, Rectifier PC (Rev B)	1-80307A21	05760601	REF
CR1-4	DIODE, Rectifier 50V, 1N4719	48-82525G07	720453	4
CR5-10	DIODE, Rectifier 50V, 30S05	48-83739K36	103252	6
	SPACER, 6-32 x 1/4	43-80329A77	100783	4
	LUG, Terminal	28-84209D52	100508	11
	BOARD, PC		057606	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A3, MOTHERBOARD PC ASSEMBLY #1-80307A22

REF. #	DESCRIPTION	MOTOROLA PART NO.	S–D PART NO.	QTY PER ASSY
A3	ASSEMBLY, Mother Board PC (Rev C)	1-80307A22	05790001 1	REF
C1	CAPACITOR, Ceramic, .001 µF 20%, 50V	21-82187B14	100251	2
C2	Same as C1			
C3	CAPACITOR, Tant, 1 µF 10%, 35V	23-82783B26	100082	4
C4	CAPACITOR, Disc, .01 µF +80-20%, 100V	21-84309A25	100103	6
C5	CAPACITOR, Tant, 6.8 µF 10%, 35V	23-84677D12	100182	2
C6	Same as C5			
C7	Same as C4			
C8	Same as C4			
C9	Same as C4			
C10	Same as C4			
C11	Same as C3			
C12	Same as C3			
C13	Same as C4			
C14	Same as C3			
CR1	DIODE, Signal 70V, 5082-2800	48-84309A58	100442	1
CR2	DIODE, Signal 50V, 1N4151	48-84309A57	100385	4
CR3	Same as CR2			
CR4	DIODE, Rectifier 600V	48-82466H18	100413	1
CR5	Same as CR2			
CR6	Same as CR2			
Q1	Not Used			
Q2	TRANSISTOR, NPN Silicon PN2222A	48-86851C76	103735	5
Q3	TRANSISTOR, PNP Silicon 2N3640	48-84309A63	101357	2
Q4	Same as Q3			
Q5	Same as Q2			
Q6	Same as Q2			
Q7	TRANSISTOR, PNP Silicon 2N3645	48-84307A21	101367	1
Q8	Same as Q2			
Q9	Same as Q2			
R1	RESISTOR, MF, 10 k 1%, .12W	6-10621C91	101930	2
R2	RESISTOR, CC, 56 Ω 5%, 1/4W	6-124A19	101735	1
R3	RESISTOR, CC, 220 k 5%, 1/4W	6-124B06	101610	1
R4	RESISTOR, CC, 1 k 5%, 1/4W	6-124A49	101569	4
R5	Same as R4			
R6	RESISTOR, CC, 47 k 5%, 1/4W	6-124A89	101574	1
R7	RESISTOR, CC, 100 k 5%, 1/4W	6-124A97	101558	1
R8	RESISTOR, Variable, 500 k 20%, 1/2W	18-80330A85	102054	1
R9	RESISTOR, CC, 4.7 k 5%, 1/4W	6-124A65	101598	1
R10	RESISTOR, CC, 27 k 5%, 1/4W	6-124A83	101587	2

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION — A3, MOTHER PC ASSEMBLY 1-80307A22 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S–D PART NO	QTY PER ASSY
R11	RESISTOR, CC, 10 k 5%, 1/4W	6-124A73	101570	4
R12	RESISTOR, CC, 2.7 k 5%, 1/4	6-124A59	101599	1
R13	Same as R11			
R14	Same as R10			
R15	RESISTOR, CC, 820 Ω 5%, 1/4W	6-124A47	101567	1
R16	RESISTOR, CC, 22 k 5%, 1/4W	6-124A81	101572	1
R17	Same as R11			
R18	RESISTOR, CC, 120 k 5%, 1/4W	6-124A99	101580	2
R19	Same as R4			
R20	RESISTOR, CC, 10 Ω 5%, 1/4W	6-124A01	101557	1
R21	Same as R18			
R22	Same as R4			
R23	Same as R11			
R24	Same as R1			
R25	RESISTOR, CC, 150 Ω 5%, 1/4W	6-124A29	101615	1
U1	INTEGRATED CIRCUIT, LM301	51-84204D30	025745	1
VR1	DIODE, Zener, 1N961B	48-83624E02	100395	1
	CONNECTOR, PC Edge 22-pin	28-80321A58	102806	6
	SOCKET, Receptical 12-pin	15-80319A97	102809	1
	SOCKET, Receptical 9-pin	15-80319A95	102812	1
	GUIDE, Card	46-80330A78	102781	2
	SOCKET, Pin PC Mount	29-80330A95	10282206	16
	TERMINAL, Swage	29-84209D51	100482	85
	TERMINAL, Swage	29-84209D52	100508	8
	STANDOFF, 4-40 x 3/8	43-80329A78	100973	2
	SCREW, PHMS 4-40 x 1/2	3-80329A68	10062608	2
	WASHER, Split #4	4-114585	100711	2
	WASHER, Flat #4	4-7607	100703	2

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A3A1, SWITCH PC ASSEMBLY #1-80307A23

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
A3A1	ASSEMBLY, Switch PC (Rev B)	1-80307A23	05754101	REF
CR1 thru CR28	DIODE, Signal 50V 1N4151	48-84309A57	100385	28
R1	RESISTOR, CC, 470 k 5%, 1/4W	6-124B14	101630	4
R2	Same as R1			
R3	Same as R1			
R4	Same as R1			
U1	INTEGRATED CIRCUIT, MC14028BCP BCD-to-Dec Decoder	51-82822F47	045286	1
U2	INTEGRATED CIRCUIT, MC14050CP Inverted Buffer	51-82822F41	103492	1
	ASSEMBLY, Switch	1-80307A31	057689	1
	CONNECTOR, Molex 9-pin	15-80319A85	102811	1
	CONNECTOR, Terminals	29-84706E01	10282205	9
	BOARD, PC		057541	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A3A2, DISPLAY PC ASSEMBLY #1-80307A24

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
A3A2	ASSEMBLY, Display PC (Rev E)	1-80307A24	05754401	REF
C1	CAPACITOR, Ceramic .01 µF +80-20%, 100V	21-84309A25	100103	2
C2	CAPACITOR, Tant, 1 µF 10%, 35V	23-82783B26	100082	1
C3	CAPACITOR, Tant, 100 µF 10%, 20V	23-83819K65	100208	2
C4	CAPACITOR, Mylar .1 µF 10%, 200V	8-82095G13	100199	2
C5	Same as C4			
C6	CAPACITOR, Tant, 39 µF 10%, 10V	23-82783B36	100183	1
C7	Same as C3			
C8	Not Used			
C9	Same as C1			
CR1	DIODE, Signal 50V 1N4151	48-84309A57	100385	3
CR2	Not Used			
CR3	Same as CR1			
CR4	Same as CR1			
DS1	DISPLAY, LED Indicator 7-segment	48-80330A78	10317201	4
DS2	Same as DS1			
DS3	Same as DS1			
DS4	Same as DS1			
DS5	DISPLAY, LED MV5153	48-83739K30	103201	6
DS6	Same as DS5			
DS7	Same as DS5			
DS8	Same as DS5			
DS9	Same as DS5			
DS10	Same as DS5			
Q1	TRANSISTOR, NPN Silicon 2N3646	48-84305A20	101369	1
Q2	Not Used			
Q3	TRANSISTOR, NPN Silicon MPSA12	48-84208D67	101396	4
Q4	Same as Q3			
Q5	Same as Q3			
Q6	Same as Q3			
Q7	TRANSISTOR, PNP Silicon PN3645	48-84307A21	101367	2
Q8	Same as Q7			
R1	RESISTOR, MF, 1 k 1%, 1/8W	6-84205D22	102097	1
R2	RESISTOR, CC, 18 k 5%, 1/4W	6-124A79	101579	1
R3	RESISTOR, MF, 5.76 k 1%, 1/8W	6-10621C68	103424	1
R4	RESISTOR, MF, 2.74 k 1%, 1/8W	6-10621C37	106178	1
R5	RESISTOR, CC, 470 Ω 5%, 1/4W	6-124A41	101625	1
R6	RESISTOR, CC, 470 k 5%, 1/4W	6-124B14	101630	1
R7	RESISTOR, CC, 330 k 5%, 1/4W	6-124B10	101658	1
R8	Not Used			

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A3A2, DISPLAY PC ASSEMBLY #1-80307A24

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
R9	RESISTOR, CC, 4.7 k 5%, 1/4W	6-124A65	101598	1
R10	RESISTOR, CC, 15 Ω 5%, 1/4W	6-124A65	101764	11
R11	Same as R10			
R12	Same as R10			
R13	Same as R10			
R14	Same as R10			
R15	Same as R10			
R16	Same as R10			
R17	Same as R10			
R18	Same as R10			
R19	RESISTOR, CC, 120 Ω 5%, 1/4W	6-124A27	101717	6
R20	Same as R19			
R21	Same as R19			
R22	Same as R19			
R23	RESISTOR, CC, 1 k 5%, 1/4W	6-124A49	101569	4
R24	Same as R23			
R25	Same as R19			
R26	Same as R23			
R27	Same as R23			
R28	Same as R19			
R29	Same as R10			
R30	Same as R10			
U1	INTEGRATED CIRCUIT, MC14433 A-D Converter	51-80330A72	117326	1
U2	INTEGRATED CIRCUIT, SN74LS247 4-7 Decade Driver	51-80332A11	103166	1
U3	INTEGRATED CIRCUIT, MC14013 CMOS, Dual D Flip-Flop	51-83739K25	103199	1
U4	INTEGRATED CIRCUIT, MC3002P Quad 2-Input NOR Gate	51-84204D29	025739	1
VR1	DIODE, Reference 6.2V 1N827	48-80330A79	100386	1
VR2	DIODE, Zener 6.2V	48-82256C15	100378	1
	SPACER, LED 5/8	43-80330A91	117223	6
	SOCKET, WW 14-pin	9-80329A96	102928	4
	SOCKET, Spacer	43-80330A92	057605	2
	SOCKET, 24-pin	9-84881F02	103845	1
	BOARD, PC		057544	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A3A3, MOD CONTROL PC ASSEMBLY #1-80307A25

REF. #	DESCRIPTION	MOTOROLA PART NO.	S–D PART NO.	QTY PER ASSY
A3A3	ASSEMBLY, Mod Control PC (Rev F)	1-80307A25	05788201	REF
C1	CAPACITOR, DISC, .01 µF +80-20%, 100V	21-84309A25	100103	10
C2	CAPACITOR, DISC, .001 µF 20%, 50V	21-82187B14	100251	1
C3	CAPACITOR, DISC, .1 µF 20%, 50V	21-84209D49	100178	1
C4	CAPACITOR, Tant, 1 µF 10%, 35V	23-82783B26	100082	2
C5	CAPACITOR, DM, 318 pF 1%, 500V	21-84205D46	100244	3
C6	Same as C5			
C7	Same as C5			
C8	Same as C4			
C9	CAPACITOR, Disc, 10 pF 1 kV	21-80321A38	100282	1
C10	CAPACITOR, Disc, 15 pF 5%, 1 kV	21-80321A37	100355	1
C11	CAPACITOR, Disc, 33 pF 10%, 1 kV	21-84205D39	100054	1
C12	CAPACITOR, Tant, 10 µF 10%, 20V	23-82788B27	100063	1
C13	Same as C1			
C14	CAPACITOR, ELAX, 100 µF 25V	23-82683B04	100165	2
C15	Same as C14			
C16	Same as C1			
C17	Same as C1			
C18	Same as C1			
C19	Same as C1			
C20	Same as C1			
C21	Same as C1			
C22	Same as C1			
C23	Same as C1			
CR1	DIODE, Signal Fixed FD300	48-84204D09	102703	11
CR2	Same as CR1			
CR3	DIODE, Signal 50V	48-84309A57	100385	4
CR4	Same as CR3			
CR5	Same as CR3			
CR6	Same as CR3			
CR7	Same as CR1			
CR8	Same as CR1			
CR9	Same as CR1			
CR10	Same as CR1			
CR11	Same as CR1			
CR12	Same as CR1			
CR13	Same as CR1			
CR14	Same as CR1			
CR15	Same as CR1			
Q1	TRANSISTOR, PNP Silicon PN3645	48-84307A21	101367	3
Q2	TRANSISTOR, NPN Silicon PN2222	48-86851C76	103735	3
Q3	Same as Q1			

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A3A3, MOD CONTROL PC ASSEMBLY #1-80307A25 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO	QTY PER ASSY
Q4	Same as Q2			
Q5	Same as Q1			
Q6	TRANSISTOR, JFET N-Channel 2N4091 1	48-82778K03	101409	4
Q7	Same as Q6			
Q8	TRANSISTOR, JFET P-Channel 2N4342	48-84305A18	101374	1
Q9	Same as Q6			
Q10	Same as Q2			
Q11	Same as Q6			
R1	RESISTOR, CC, 100 k 5%, 1/4W	6-124A97	101558	9
R2	Same as R1			
R3	Same as R1			
R4	RESISTOR, CC, 10 k 5%, 1/4W	6-124A73	101570	5
R5	RESISTOR, CC, 12 k 5%, 1/4W	6-124A75	101565	2
R6	RESISTOR, CC, 220 Ω 5%, 1/2W		101667	2
R7	RESISTOR, CC, 10 Ω 5%, 1/4W	6-124A01	101557	2
R8	Same as R7			
R9	Same as R6			
R10	RESISTOR, CC, 3.3 k 5%, 1/4W	6-124A61	101559	2
R11	Same as R10			
R12	Same as R4			
R13	Same as R4			
R14	Same as R1			
R15	RESISTOR, Variable, 20 k 10%, 3/8W	18-84205D07	102470	1
R16	Not Used			
R17	Same as R1			
R18	Same as R1			
R19	RESISTOR, Variable, 50 k 10%, 3/8W	18-80321A16	102153	1
R20	RESISTOR, MF, 20 k 1%, 1/8W	6-10621D21	106172	4
R21	RESISTOR, MF, 49.9 k 1%, 1/8W	6-10621D59	102296	1
R22	RESISTOR, MF, 866 k 1%, 1/8W	6-80321A43	103357	2
R23	Same as R22			
R24	RESISTOR, MF, 71.5 k 1%, 1/8W	6-10621D74	106199	1
R25	RESISTOR, CC, 4.7 k 5%, 1/4W	6-124A65	101598	3
R26	Same as R4			
R27	Same as R20			
R28	RESISTOR, MF, 12.1 k 1%, 1/8W	6-10621C03	106165	1
R29	Same as R4			
R30	RESISTOR, Variable, 25 k 10%, 1/2W	18-80330A86	106136	2
R31	RESISTOR, MF, 10 k 1%, 1/8W	6-10621C91	106162	5
R32	RESISTOR, MF, 237 k 1%, 1/8W	6-10621E25	106227	1
R33	RESISTOR, Variable, 250 k 10%, 1/2W	18-83819K57	106137	

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A3A3, MOD CONTROL PC ASSEMBLY #1-80307A25 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
R34	RESISTOR, CC, 18 k 5%, 1/4W	6-124A79	101579	1
R35	RESISTOR, MF, 40.2 k 1%, 1/8W	6-10621D50	102148	1
R36	Same as R1			
R37	RESISTOR, Variable, 10 k 10%, 3/8W	18-84209D26	102472	2
R38	RESISTOR, MF, 6.81 k 1%, 1/8W	6-10621C75	103741	1
R39	Same as R5			
R40	RESISTOR, MF, 100 k 1%, 1/8W	6-84205D16	102525	1
R41	Same as R30			
R42	Same as R31			
R43	Same as R20			
R44	Same as R31			
R45	Same as R25			
R46	Same as R31			
R47	Same as R25			
R48	Same as R20			
R49	Same as R1			
R50	Same as R1			
R51	Same as R31			
R52	Same as R37			
R53	RESISTOR, MF, 51.1 k 1%, 1/8W	6-10621D60	106192	1
R54	RESISTOR, MF, 13.7 k 1%, 1/8W	6-10621D05	106208	1
R55	RESISTOR, Variable, 100 k 10%, 1/2W	18-80330A87	106135	1
R56	RESISTOR, CC, 10 M 5%, 1/4W	6-124A46	101564	1
R57	RESISTOR, CC, 47 k 5%, 1/4W	6-124A89	101574	1
U1	INTEGRATED CIRCUIT, MC14071CP CMOS, 2-Input OR Gate	51-82822F43	103940	1
U2	INTEGRATED CIRCUIT, LM324N Operational Amplifier	51-84320A80	103198	1
U3	INTEGRATED CIRCUIT, LM741 Operational Amplifier	51-80330A73	103708	2
U4	INTEGRATED CIRCUIT, LM301 Operational Amplifier	51-84204D30	025745	1
U5	INTEGRATED CIRCUIT, LF355 Operational Amplifier	51-80330A74	103701	1
U6	Same as U3			
U7	INTEGRATED CIRCUIT, FN Resistor Module, 4-12k 20%, .1W	51-83819K50	045008	1
	TERMINAL, Swage	29-80321A65	100496	3
	BOARD, PC		057882	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4, SYNTHESIZER ASSEMBLY #1-80307A30

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
A4	ASSEMBLY, Synthesizer (Rev B)	1-80307A30	057436	REF
1	ASSEMBLY, Synthesizer Box Mech		055929	1
2	ASSEMBLY, Left Gusset		057438	1
3	ASSEMBLY, Right Gusset		057435	1
4	ASSEMBLY, Bottom Cover		055976	1
5	ASSEMBLY, Top Cover		057437	1
6	ASSEMBLY, Cable/Mother Board, A15		057228	1
7	FINGER STOCK, RFI	32-82778K48	101053	A/R
8	GASKET, RFI Round		103274	A/R
9	HEATSINK	7-80329A80	055679	1
11	SCREW, PHMS 2-56 x 3/16	3-80311A72	10062503	6
12	SCREW, PHMS 4-40 x 1/4	3-80311A60	10062604	12
13	SCREW, PHMS 6-32 x 1/4	3-80311A26	10063204	4
14	SCREW, PHMS 6-32 x 5/16	3-80311A23	10063205	28
15	SCREW, PHMS 6-32 x 7/16	3-80311A61	10063207	6
16	SCREW, FHMS 6-32 x 5/16	3-80327A84	10073105	22
36	SCREW, PHMS 6-32 x 3/8	3-80311A24	10063206	
17	WASHER, Flat #2	4-80311A76	100614	6
18	WASHER, Split #2	4-400139	100661	6
19	WASHER, Flat #4	4-7607	100703	12
20	WASHER, Split #4	4-114583	100711	12
21	WASHER, Flat #6	4-1720	100704	4
22	WASHER, Split #6	4-7669	100712	59
A4A1	PC ASSEMBLY, AC Discriminator	1-82778K16	05563901	1
A4A2	PC ASSEMBLY, 10 MHz VCO	1-82778K17	05566201	1
A4A3	PC ASSEMBLY, DC Discriminator	1-82822K93	05537401	1
A4A4	PC ASSEMBLY, Time Base	1-82822K92	05395401	1
A4A5	PC ASSEMBLY, Source 2	1-82822K87	05362401	1
A4A6	PC ASSEMBLY, Source 3	1-82822K88	05373501	1
A4A8	PC ASSEMBLY, 400 MHz Reference Gen	1-82877K18	05566801	1
A4A9	PC ASSEMBLY, Logic	1-82778K20	05567101	1
A4A10	PC ASSEMBLY, Divide-By-N	1-82778K19	05567001	1
A4A11	PC ASSEMBLY, Source 4	1-82822K89	05572401	1
A4A12	PC ASSEMBLY, Phase Detector	1-82822K94	05538501	1
A4A13	PC ASSEMBLY, Source 5	1-80307A65	05797001	1
A4A14	PC ASSEMBLY, Amplifier	1-82822K91	05392901	1
A4A15	PC ASSEMBLY, Mother Board	1-82778K28	05569201	1
A4A16	PC ASSEMBLY, Mixer	1-82822K98	05547001	1
A4A17	PC ASSEMBLY, Connector	1-82778K29	05569301	1
A4A18	PC ASSEMBLY, L.O. Switch	1-80306A45	05715301	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION: A4A1, AC DISCRIMINATOR PC ASSEMBLY #1-82778K16

REF. #	DESCRIPTION	MOTOROLA PART NO.	S–D PART NO.	QTY PER ASSY
A4A1	ASSEMBLY, AC Discriminator (Rev E)	1-82778K16	05563901	REF
C1	CAPACITOR, Ceramic, .1 µF +80-20%, 10V	21-84309A26	100120	1
C2	Not Used			
C3	CAPACITOR, Ceramic, .1 µF 20%, 50V	21-84209D49	100178	4
C4	Same as C3			
C5	CAPACITOR, Ceramic, .01 µF 20%, 100V	21-84309A25	100103	10
C6	CAPACITOR, Tant, 22 µF 10%, 15V	23-82783B32	100125	1
C7	Same as C3			
C8	Same as C5			
C9	Same as C5			
C10	Not Used			
C11	Same as C5			
C12	Not Used			
C13	CAPACITOR, Mica, 47 pF 5%, 500V	21-868681	100171	3
C14	CAPACITOR, Ceramic, 1000 pF 20%, 1 kV	21-84309A49	100076	1
C15	Same as C13			
C16	Same as C3			
C17	CAPACITOR, Varcer, 9.0-35 pF	20-84209D87	100159	1
C18	Same as C5			
C19	Same as C5			
C20	Not Used			
C21	CAPACITOR, Tant, 1 µF 10%, 35V	23-82783B26	100082	1
C22	Same as C5			
C23	Same as C13			
C24	CAPACITOR, Mylar, 1 µF 20%, 100V	21-84208D96	100056	1
C25	Same as C5			
C26	Not Used			
C27	Same as C5			
C28	CAPACITOR, Mica, 470 pF 5%, 300V	21-82537B06	100221	1
C29	Same as C5			
CR1	DIODE, Variable Capacitor, 22 pF	48-84204D06	100449	1
CR2	DIODE, Signal 50V, 1N4151	48-84309A57	100385	3
CR3	Same as CR2			
CR4	Same as CR2			
L1	INDUCTOR, Fixed, 100 µH 10%	24-84209D01	101320	1
L2	INDUCTOR, Fixed, 27 µH 5%	24-80321A27	101308	1
L3	INDUCTOR, Fixed, 2.7 µH 10%	24-84204D55	101299	1
Q1	TRANSISTOR, NPN Silicon 2N3643	48-83227D08	101358	1
Q2	TRANSISTOR, PNP Silicon 2N3906	48-83358H10	101378	1
Q3	TRANSISTOR, NPN Silicon 2N3904	48-84066A57	101377	2

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A1, AC DISCRIMINATOR #1-82778K16 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
Q4	Same as Q3			
Q5	TRANSISTOR, PNP Silicon 2N3645	48-84307A21	101367	1
R1	RESISTOR, Variable, 2 k 10%, 3/8W	18-84209D25	102119	1
R2	RESISTOR, MF, 2 k 1%, 1/8W	6-10621C24	106224	1
R3	RESISTOR, MF, 31.6 k 1%, 1/8W	6-10621D40	102941	1
R4	RESISTOR, CC, 4.7 k 5%, 1/4W	6-124A65	101598	2
R5	RESISTOR, CC, 1.8 k 5%, 1/4W	6-124A55	101602	1
R6	RESISTOR, CC, 51 Ω 5%, 1/4W	6-124A18	101672	1
R7	RESISTOR, CC, 100 k 5%, 1/4W	6-124A97	101558	2
R8	RESISTOR, CC, 10 k 5%, 1/4W	6-124A73	101570	4
R9	RESISTOR, CC, 2.7 k 5%, 1/4W	6-124A59	101599	1
R10	RESISTOR, CC, 2.2 k 5%, 1/4W	6-124A57	101562	1
R11	RESISTOR, CC, 120 k 5%, 1/4W	6-124A99	101580	1
R12	RESISTOR, CC, 10 M 5%, 1/4W	6-124A46	101564	3
R13	Same as R4			
R14	Same as R12			
R15	RESISTOR, CC, 1 k 5%, 1/4W	6-124A49	101569	3
R16	RESISTOR, CC 33 k 5%, 1/4W	6-124A85	101576	1
R17	Not Used			
R18	RESISTOR, Variable, 10 k 10%, 3/8W	18-84209D26	102472	1
R19	Not Used			
R20	Same as R7			
R21	Not Used			
R22	RESISTOR, CC, 27 k 5%, 1/4W	6-124A83	101587	2
R23	Same as R22			
R24	Same as R12			
R25	Same as R15			
R26	Same as R8			
R27	RESISTOR, CC, 47 k 5%, 1/4W	6-124A89	101574	1
R28	Same as R15			
R29	Same as R8			
R30	Same as R8			
TP1 thru TP5	TERMINAL, Swage Test Point	29-80321A65	100496	5
U1	INTEGRATED CIRCUIT, CMOS 14016CP	51-82822F12	103323	1
U2	INTEGRATED CIRCUIT, Op Amp LM301A	51-84204D30	025745	1
U3	INTEGRATED CIRCUIT, CA3089E Limiter Detector	51-84320A78	045261	1
U4	INTEGRATED CIRCUIT, Op Amp CA3130T	51-83819K39	103231	2
U5	Same as U4			
	BOARD, PC		055639	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A2, 10 MHz VCO PC ASSEMBLY #1-82778K17

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
A4A2	ASSEMBLY, 10 MHz VCO (Rev E)	1-82778K17	05566201	REF
C1	CAPACITOR, Ceramic .1 µF +80-20%, 10V	21-84309A26	100120	3
C2	Same as C1			
C3	CAPACITOR, Ceramic, .1 µF 20%, 50V	21-84209D49	100178	3
C4	Same as C3			
C5	Not Used			
C6	Same as C3			
C7	CAPACITOR, Mica Crimp Lead 1000 pF 5%, 100V	21-84309A47	100243	1
C8	CAPACITOR, Mica Crimp Lead 33 pF 5%, 500V	21-847772	100175	2
C9	CAPACITOR, Ceramic .01 µF +80-20%, 100V	21-84309A25	100103	19
C10	Same as C9			
C11	CAPACITOR, Tant, 22 µF 10%, 15V	23-82783B32	100125	1
C12	Same as C9			
C13	Same as C9			
C14	CAPACITOR, Mica, 120 pF 5%, 500V	21-840713	100223	1
C15	CAPACITOR, Mica, 56 pF 5%, 500V	21-82537B21	100179	1
C16	CAPACITOR, Mica, 100 pF 20%, 50V	21-82187B14	100251	9
C17	CAPACITOR, Ceramic 1000 pF 20%, 1 kV	21-84309A49	100076	4
C18	Same as C17			
C19	Same as C1			
C20	CAPACITOR, Tant, 1 µF 10%, 35V	23-82783B26	100082	1
C21	Same as C9			
C22	Same as C16			
C23	Same as C16			
C24	Same as C9			
C25	Same as C16			
C26	Same as C9			
C27	Same as C9			
C28	Same as C9			
C29	Same as C16			
C30	Same as C9			
C31	Same as C16			
C32	Same as C9			
C33	Same as C17			
C34	Same as C9			
C35	Same as C9			
C36	Same as C9			
C37	Same as C17			

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A2, 10 MHz VCO PC ASSEMBLY #1-82778K17 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
C38	Same as C9			
C39	Same as C16			
C40	Same as C9			
C41	Same as C9			
C42	Same as C9			
C43	Same as C16			
C44	Same as C16			
C45	CAPACITOR, Varcer, 15-60 pF, 200V	20-82778K74	106502	1
C46	Same as C9			
C47	Not Used			
C48	Not Used			
C49	Same as C8			
CR1	DIODE, Signal 50V 1N4151	48-84309A57	100385	13
CR2	Same as CR1			
CR3	Same as CR1			
CR4	DIODE, Vari Capacitor, 22 pF MV2107	48-84204D06	100449	1
CR5	Same as CR1			
CR6	Same as CR1			
CR7	Same as CR1			
CR8	Same as CR1			
CR9	Same as CR1			
CR10	Same as CR1			
CR11	Same as CR1			
CR12	Same as CR1			
CR13	Same as CR1			
CR14	Same as CR1			
L1	INDUCTOR, Fixed 100 µH 10%	24-84209D01	101320	8
L2	INDUCTOR, Fixed 6.8 µH 10%	24-84204D56	101300	1
L3	Not Used			
L4	Same as L1			
L5	Not Used			
L6	Same as L1			
L7	Same as L1			
L8	Same as L1			
L9	Same as L1			
L10	Same as L1			
L11	Same as L1			
Q1	TRANSISTOR, NPN Silicon 2N3904	48-84066A57	101377	8
Q2	TRANSISTOR, PNP Silicon 2N3906	48-83358H10	101378	1
Q3	TRANSISTOR, MOSFET N-Channel MFE121	48-84204D18	101413	1
Q4	Same as Q1			
Q5	Same as Q1			

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A2, 10 MHz VCO PC ASSEMBLY #1-82778K17 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
Q6	Same as Q1			
Q7	Same as Q1			
Q8	Same as Q1			
Q9	Same as Q1			
Q10	Same as Q1			
Q11	TRANSISTOR, JFET N-Channel 2N4091	48-82778K03	101409	1
R1	RESISTOR, CC 10 k 5%, 1/4W	6-124A73	101570	4
R2	RESISTOR, CC 27 k 5%, 1/4W	6-124A83	101587	2
R3	Same as R2			
R4	RESISTOR, CC 220 Ω 5%, 1/4W	6-124A33	101566	3
R5	RESISTOR, MF 31.6 k 1%, 1/8W	6-10621D40	102941	1
R6	Not Used			
R7	Not Used			
R8	Not Used			
R9	RESISTOR, MF 20 k 1%, 1/8W	6-10621D21	106315	1
R10	RESISTOR, CC 120 k 5%, 1/4W	6-124A99	101580	2
R11	Same as R10			
R12	RESISTOR, CC 12 k 5%, 1/4W	6-124A75	101565	1
R13	RESISTOR, CC 220 k 5%, 1/4W	6-124B06	101610	1
R14	RESISTOR, CC 100 k 5%, 1/4W	6-124A97	101558	1
R15	Same as R1			
R16	RESISTOR, CC 22 k 5%, 1/4W	6-124A81	101572	1
R17	RESISTOR, CC 100 Ω 5%, 1/4W	6-124A25	101609	10
R18	Not Used			
R19	RESISTOR, CC 1 k 5%, 1/4W	6-124A49	101569	13
R20	Same as R19			
R21	RESISTOR, CC 1.8 k 5%, 1/4W	6-124A55	101602	1
R22	RESISTOR, CC 3.3 k 5%, 1/4W	6-124A61	101559	2
R23	Same as R19			
R24	Same as R19			
R25	Same as R19			
R26	RESISTOR, CC 51 Ω 5%, 1/4W	6-124A18	101672	1
R27	Same as R19			
R28	Same as R19			
R29	Same as R22			
R30	Same as R4			
R31	Same as R17			
R32	Same as R19			
R33	RESISTOR, CC 270 Ω 5%, 1/4W	6-124A35	101542	5
R34	Same as R4			
R35	Same as R17			

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A2, 10 MHz VCO PC ASSEMBLY #1-82778K17 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S–D PART NO.	QTY PER ASSY
R36	Same as R17			
R37	Same as R19			
R38	Same as R17			
R39	RESISTOR, CC 2.2 k 5%, 1/4W	6-124A57	101562	3
R40	Same as R33			
R41	Same as R33			
R42	Same as R33			
R43	Same as R17			
R44	Same as R39			
R45	Same as R33			
R46	Same as R19			
R47	Same as R19			
R48	RESISTOR, CC 56 Ω 5%, 1/4W	6-124A19	101735	1
R49	Same as R17			
R50	Same as R17			
R51	Same as R17			
R52	Same as R17			
R53	Same as R39			
R54	RESISTOR, CC 470 Ω 5%, 1/4W	6-124A41	101625	1
R55	RESISTOR, MF 10 k 1%, 1/8W	6-84205D23	102098	2
R56	Same as R55			
R57	Same as R1			
R58	RESISTOR, CC 22 M 5%, 1/4W	6-124B54	101628	1
R59	RESISTOR, CC 10 Ω 5%, 1/4W	6-124A01	101557	2
R60	Same as R59			
R61	Same as R19			
R62	RESISTOR, CC 2.2 M 5%, 1/4W	6-124A41	101618	1
R63	RESISTOR, Variable 50 k 10%, 3/8W	18-80321A16	102153	1
R64	Same as R19			
R65	Same as R1			
TP1	TERMINAL, Swage Test Point	29-80321A65	100496	2
TP2	Same as TP1			
U1	INTEGRATED CIRCUIT, LM201A Selected Operational Amplifier	51-82778K06	037913	2
U2	Same as U1			
U3	INTEGRATED CIRCUIT, CA3076 Linear Amplifier	51-84204D36	025770	2
U4	Same as U3			
	BOARD, PC		055662	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A3, DC DISCRIMINATOR PC ASSEMBLY #1-82822K93

REF. #	DESCRIPTION	MOTOROLA PART NO.	S–D PART NO.	QTY PER ASSY
A4A3	ASSEMBLY, DC Discriminator (Rev F)	1-82822K93	05537401	REF
C1	CAPACITOR, Tant 1 µF 10%, 35V	23-82788B26	100082	4
C2	Not Used			
C3	CAPACITOR, Ceramic .01 µF +80-20%, 100V	21-84309A25	100103	13
C4	CAPACITOR, Ceramic, .1 µF 20%, 50V	21-84209D49	100178	7
C5	CAPACITOR, DM 47 pF 5%, 500V	21-868681	100171	5
C6	Same as C3			
C7	CAPACITOR, Disc 1 µF 20%, 100V	21-84208D96	100056	3
C8	Same as C4			
C9	Same as C5			
C10	Not Used			
C11	Same as C3			
C12	Same as C3			
C13	Same as C4			
C14	CAPACITOR, Ceramic .001 µF 20%, 1 kV	21-84309A49	100076	1
C15	CAPACITOR, Tant 22 µF 10%, 15V	23-82783B32	100125	1
C16	Same as C3			
C17	Same as C3			
C18	Same as C4			
C19	Same as C4			
C20	Same as C3			
C21	Same as C4			
C22	Same as C4			
C23	CAPACITOR, Ceramic 1000 pF 20%, 50V	21-82187B14	100251	1
C24	Same as C5			
C25	CAPACITOR, Varcer 9-35 pF	20-84209D87	100159	1
C26	Same as C3			
C27	CAPACITOR, Ceramic 1 µF 20%, 50V	21-84208D96	100176	1
C28	Same as C5			
C29	Same as C1			
C30	Same as C3			
C31	Same as C3			
C32	Same as C5			
C33	Same as C7			
C34	Same as C7			
C35	CAPACITOR, DM 33 pF 5%, 500V	21-817772	100175	1
C36	Same as C3			
C37	Same as C3			
C38	CAPACITOR, Tant 39 µF 10%, 10V	23-82783B36	100183	2
C39	CAPACITOR, Ceramic .1 µF+80-20%,10V	21-84309A26	100120	2
C40	Same as C38			

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A3, DC DISCRIMINATOR #1-82822K93 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S–D PART NO.	QTY PER ASSY
C41	Same as C39			
C42	Same as C1			
C43	Same as C1			
C44	Same as C3			
C45	CAPACITOR, DM 470 pF 5%, 300V Crimp	21-82537B06	100221	1
CR1	DIODE, Signal 50V, 1N4151	48-84309A57	100385	3
CR2	Same as CR1			
CR3	Same as CR1			
CR4	DIODE, Variable Cap, 22 pF, MV2107	48-84204D06	100449	1
L1	INDUCTOR, Fixed 100 µH 10%	24-84209D01	101320	4
L2	Same as L1			
L3	Same as L1			
L4	Same as L1			
L5	INDUCTOR, Fixed 27 µH 5%	24-80321A27	101308	1
L6	INDUCTOR, Fixed 2.7 µH 10%	24-84204D65	101327	1
Q1	TRANSISTOR, NPN Silicon 2N3904	48-84066A57	101377	2
Q2	TRANSISTOR, NPN Silicon 2N3643	48-83227D08	101358	1
Q3	Same as Q1			
R1	RESISTOR, CC 10 k 5%, 1/4W	6-124A73	101570	6
R2	RESISTOR, CC 47 k 5%, 1/4W	6-124A89	101574	2
R3	Same as R1			
R4	Same as R1			
R5	Not Used			
R6	Not Used			
R7	RESISTOR, CC 1 k 5%, 1/4W	6-124A49	101569	8
R8	Same as R7			
R9	Same as R7			
R10	Same as R7			
R11	Same as R7			
R12	RESISTOR, CC 2.2 k 5%, 1/4W	6-124A57	101562	1
R13	RESISTOR, CC 51 Ω 5%, 1/4W	6-124A18	101672	1
R14	RESISTOR, CC 470 k 5%, 1/4W	6-124B14	101630	3
R15	RESISTOR, CC 4.7 k 5%, 1/4W	6-124A65	101598	2
R16	Same as R14			
R17	Same as R15			
R18	RESISTOR, Variable 2 k 10%, 3/8W	18-84209D25	102119	1
R19	RESISTOR, MF 2 k 1%, 1/8W	6-10621C24	106224	1
R20	RESISTOR, MF 31.6 k 1%, 1/8W	6-10621D40	102941	1
R21	RESISTOR, CC 150 Ω 5%, 1/4W	6-124A29	101615	1
R22	Same as R1			
R23	Same as R7			

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A3, DC DISCRIMINATOR #1-82822K93 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S–D PART NO.	QTY PER ASSY
R24	RESISTOR, CC 100 k 5%, 1/4W	6-124A97	101558	3
R25	Same as R24			
R26	Same as R24			
R27	Same as R1			
R28	Same as R14			
R29	RESISTOR, Variable 50 k 10%, 3/8W	18-80321A16	102153	1
R30	Same as R1			
R31	RESISTOR, CC 120 k 5%, 1/4W	6-124A99	101580	1
R32	RESISTOR, CC 270 Ω 5%, 1/4W	6-124A35	101542	1
R33	Same as R2			
R34	Same as R7			
R35	Same as R7			
TP1	TERMINAL, Swage	29-80321A65	100496	6
TP2	Same as TP1			
TP3	Same as TP1			
TP4	Same as TP1			
TP5	Same as TP1			
TP6	Same as TP1			
U1	INTEGRATED CIRCUIT, MC14107CP CMOS Decade Counter	51-82822F21	103324	1
U2	INTEGRATED CIRCUIT, MC14001CP CMOS Quad 2-Input NOR Gate	51-82822F03	045283	1
U3	INTEGRATED CIRCUIT, CA3026 Linear Amp	51-80321A67	025724	1
U4	INTEGRATED CIRCUIT, CA3076 Linear Amp	51-84204D36	025770	1
U5	INTEGRATED CIRCUIT, CA3089E Limiter Detector	51-84320A78	045261	1
U6	INTEGRATED CIRCUIT, CA3130T Operational Amplifier	51-83819K39	103231	2
U7	Same as U6			
U8	INTEGRATED CIRCUIT, MC14016P 4 Bi-Lateral Switch	51-82822F12	103323	1
U9	INTEGRATED CIRCUIT, LM201A Selected Operational Amplifier	51-82778K06	037913	1
	BOARD, PC		055374	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A4, TIME BASE PC ASSEMBLY #1-82822K92

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
A4A4	ASSEMBLY, Time Base (Rev B)	1-82822K92	05395401	REF
C1	CAPACITOR, Ceramic .001 µF 20%, 50V	21-82187B14	100251	2
C2	Same as C1			
C3	CAPACITOR, Ceramic 1 µF 20%, 50V	21-84208D96	100176	2
C4	CAPACITOR, Ceramic .1 µF 20%, 50V	21-84209D49	100178	4
C5	Same as C4			
C6	CAPACITOR, Tant 1 µF 10%, 35V	23-82783B26	100082	2
C7	Same as C6			
C8	Same as C3			
C9	Same as C4			
C10	Same as C4			
C11	CAPACITOR, Tant 56 µF 10%, 6V	23-84309A31	100225	1
C12	CAPACITOR, Ceramic .01 µF +80-20%, 100V	21-84309A25	100103	1
CR1	DIODE, Signal 50V 1N4151	48-84309A57	100385	9
CR2	Same as CR1			
CR3	Same as CR1			
CR4	Same as CR1			
CR5	Same as CR1			
CR6	Same as CR1			
CR7	Same as CR1			
CR8	Same as CR1			
CR9	Same as CR1			
Q1	TRANSISTOR, NPN Silicon 2N3646	48-84305A20	101369	1
R1	RESISTOR, CC 100 k 5%, 1/4W	6-124A97	101558	6
R2	Same as R1			
R3	RESISTOR, CC 1 k 5%, 1/4W	6-124A49	101569	4
R4	Same as R3			
R5	RESISTOR, CC 22 k 5%, 1/4W	6-124A81	101572	2
R6	RESISTOR, CC 10 k 5%, 1/4W	6-124A73	101570	4
R7	RESISTOR, CC 4.7 k 5%, 1/4W	6-124A65	101598	3
R8	Same as R7			
R9	Same as R7			
R10	RESISTOR, CC 18 k 5%, 1/4W	6-124A79	101579	1
R11	Same as R1			
R12	Same as R1			
R13	Same as R3			
R14	RESISTOR, CC 2.7 k 5%, 1/4W	6-124A59	101599	1
R15	Same as R1			
R16	Same as R6			
R17	Same as R6			

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A4, TIME BASE PC ASSEMBLY #1-82822K92 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
R18	Same as R5			
R19	Same as R1			
R20	Same as R6			
R21	Same as R3			
TP1	TERMINAL, Swage Test Point	29-80321A65	100496	2
TP2	Same as TP1			
U1	INTEGRATED CIRCUIT, CD4099 CMOS Hex Inverter Buffer	51-82822F40	117116	3
U2	INTEGRATED CIRCUIT, MC14518CP CMOS Dual BCD Up Counter	51-82822F37	103339	2
U3	Same as U2			
U4	Same as U1			
U5	INTEGRATED CIRCUIT, SN7404N TTL SSI Hex Inverter	51-6473A05	025779	2
U6	INTEGRATED CIRCUIT, MC14028CP CMOS BCD-DEC Decoder	51-82822F47	045286	1
U7	Same as U1			
U8	Same as U5			
U9	INTEGRATED CIRCUIT, MC14528CP CMOS Dual Multivibrator	51-82822F35	045289	1
U10	INTEGRATED CIRCUIT, LM301AH Operational Amplifier	51-84204D30	025745	3
U11	Same as U10			
U12	Same as U10			
VR1	DIODE, Zener 1N753A	48-84302A09	100387	1
	BOARD, PC		053954	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION: A4A5, SOURCE 2 PC ASSEMBLY #1-82822K87

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
A4A5	ASSEMBLY, Source 2 (Rev D)	1-82822K87	05362401	REF
C1	CAPACITOR, Ceramic .001 µF 20%, 50V	21-82187B14	100251	2
C2	CAPACITOR, Tant 10 µF 10%, 20V	23-82783B27	100063	4
C3	CAPACITOR, Tant 1 µF 10%, 35V	23-82783B26	100082	3
C4	CAPACITOR, Ceramic .02 µF +60-40%, 150V	21-80321A36	100057	2
C5	CAPACITOR, DM 100 pF 5%, 500V	21-850118	100173	1
C6	Same as C2			
C7	CAPACITOR, Ceramic .01 µF +80-20%, 100V	21-84309A25	100103	7
C8	Same as C7			
C9	CAPACITOR, Tant 180 µF 10%, 6V	23-80321A32	100207	1
C10	CAPACITOR, Tant 22 µF 10%, 15V	23-82788B32	100125	2
C11	CAPACITOR, DM 47 pF 5%, 500V	21-868681	100171	1
C12	Same as C3			
C13	CAPACITOR, Ceramic .1 µF 20%, 50V	21-84209D49	100178	4
C14	Same as C3			
C15	Same as C2			
C16	Same as C7			
C17	Same as C7			
C18	Same as C7			
C19	Same as C7			
C20	Same as C7			
C21	Same as C13			
C22	Same as C10			
C23	Same as C4			
C24	Same as C13			
C25	Same as C13			
C26	Same as C2			
C27	Same as C1			
CR1	DIODE, VAriable Cap 250 pF, KV1701	48-84204D07	100452	1
CR2	DIODE, Signal 50V 1N4151	48-84309A57	100385	5
CR3	Same as CR2			
CR4	Same as CR2			
CR5	Same as CR2			
CR6	Same as CR2			
L1	INDUCTOR, Variable	24-80321A30	05399601	1
L2	INDUCTOR, Fixed 100 H 10%	24-84209D01	101320	1
Q1	TRANSISTOR, Dual Gate N-Chan.MFE121	48-84204D18	101413	1
Q2	TRANSISTOR, NPN Silicon 2N3646	48-84305A20	101369	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A5, SOURCE 2 PC ASSEMBLY #1-82822K87 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S–D PART NO.	QTY PER ASSY
R1	RESISTOR, CC 33 k 5%, 1/4W	6-124A85	101576	1
R2	RESISTOR, CC 100 k 5%, 1/4W	6-124A97	101558	1
R3	RESISTOR, CC 100 Ω 5%, 1/4W	6-124A25	101609	2
R4	RESISTOR, CC 1 k 5%, 1/4W	6-124A49	101569	5
R5	Same as R4			
R6	RESISTOR, CC 470 Ω 5%, 1/4W	6-124A41	101625	1
R7	RESISTOR, CC 10 k 5%, 1/4W	6-124A73	101570	3
R8	RESISTOR, CC 4.7 k 5%, 1/4W	6-124A65	101598	2
R9	Same as R3			
R10	Same as R4			
R11	Same as R4			
R12	Same as R7			
R13	Same as R8			
R14	Same as R4			
R15	Same as R7			
R16	RESISTOR, CC 3.3 k 5%, 1/4W	6-124A61	101559	1
R17	RESISTOR, CC 47 k 5%, 1/4W	6-124A89	101574	1
R18	RESISTOR, CC 820 k 5%, 1/4W	6-124B20	101850	1
R19	RESISTOR, Variable 50 k 10%, 3/8W	18-80321A16	102153	1
TP1	TERMINAL, Swage	29-80321A65	100496	3
TP2	Same as TP1			
TP3	Same as TP1			
U1	INTEGRATED CIRCUIT, SN74196N TTL MSI Counter/Latch Decoder	51-84084D76	025784	1
U2	Not Used			
U3	INTEGRATED CIRCUIT, MC12014L TTL MSI Counter Control Logic	51-83819K43	045263	1
U4	INTEGRATED CIRCUIT, MC4016P TTL MSI Programmable Decoder	51-84209D13	045237	5
U5	INTEGRATED CIRCUIT, SN74LS75 TTL MSI Quad Latch	51-80330A75	103133	4
U6	Same as U4			
U7	Same as U5			
U8	Same as U4			
U9	Same as U5			
U10	INTEGRATED CIRCUIT, MC4044P TTL MSI Phase-Frequency Detector	51-84688D29	045238	1
U11	Same as U4			
U12	Same as U4			
U13	Same as U5			
U14	INTEGRATED CIRCUIT, CA3130T Op Amp	51-83819K39	103231	1
	BOARD, PC		053624	1
	SOCKET, IC 16-pin	9-80313A10	117041	6

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A6, SOURCE 3 PC ASSEMBLY #1-82822K88

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
A4A6	ASSEMBLY, Source 3 (Rev D)	1-82822K88	05373501	REF
C1	CAPACITOR, Tant 10 µF 10%, 20V	23-82783B27	100063	2
C2	CAPACITOR, Ceramic .001 µF 20%, 50V	21-82187B14	100251	8
C3	Same as C2			
C4	Same as C2			
C5	CAPACITOR, DM 100 pF 5%, 500V	21-84309A44	100173	1
C6	Same as C1			
C7	Same as C2			
C8	CAPACITOR, Factory Selected			
C9	Same as C2			
C10	CAPACITOR, Ceramic .01 µF +80-20%, 100V	21-84309A25	100103	9
C11	Same as C10			
C12	Same as C10			
C13	CAPACITOR, DM 220 pF 5%, 500V	21-84309A33	100220	1
C14	CAPACITOR, DM 330 pF 5%, 500V	21-873267	100276	1
C15	CAPACITOR, DM 270 pF 5%, 500V	21-859178	100238	2
C16	Same as C10			
C17	CAPACITOR, Ceramic .1 µF 20%, 50V	21-84209D49	100178	8
C18	CAPACITOR, DM 180 pF 5%, 500V	21-865440	100237	2
C19	Same as C15			
C20	Same as C18			
C21	Same as C10			
C22	Same as C17			
C23	CAPACITOR, Tant 1 µF 10%, 35V	23-82783B26	100082	4
C24	CAPACITOR, Tant 56 µF 10%, 6V	23-84309A31	100225	1
C25	Same as C23			
C26	Not Used			
C27	Same as C23			
C28	CAPACITOR, Ceramic 1 µF 20%, 50V	21-84208D96	100176	2
C29	Same as C28			
C30	Not Used			
C31	CAPACITOR, DM 47 pF 5%, 500V	21-868681	100171	1
C32	Same as C10			
C33	Not Used			
C34	Same as C17			
C35	Same as C17			
C36	Same as C17			
C37	Not Used			
C38	Same as C10			
C39	Same as C17			
C40	Same as C17			

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A6, SOURCE 3 PC ASSEMBLY #1-82822K88 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
C41	Same as C17			
C42	Same as C2			
C43	Same as C2			
C44	Same as C2			
C45	Same as C23			
C46	Same as C10			
C47	Same as C10			
CR1	DIODE, VAriable Cap 82 pF MV2114	48-84204D03	100438	1
CR2	DIODE, Signal 50V 1N4151	48-84309A57	100385	9
CR3	Same as CR2			
CR4	Same as CR2			
CR5	Same as CR2			
CR6	Same as CR2			
CR7	Same as CR2			
CR8	Same as CR2			
CR9	Same as CR2			
CR10	Same as CR2			
L1	INDUCTOR, Fixed 10 µH 10%	24-84204D61	101317	1
L2	INDUCTOR, Variable	24-80321A30	05399601	1
L3	INDUCTOR, Fixed 100 µH 5%	24-84309A90	101306	1
L4	INDUCTOR, Fixed .47 µH 20%	24-80321A28	101318	2
L5	Same as L4			
L6	INDUCTOR, Fixed 29 µH 10%	24-80321A31	101296	2
L7	Same as L6			
L8	INDUCTOR, Fixed 1000 µH 5%	24-84204D58	101303	1
Q1	TRANSISTOR, N-Channel Dual Gate MFE121	48-84204D18	101413	1
Q2	TRANSISTOR, PNP Silicon 2N3640	48-84309A63	101357	1
Q3	TRANSISTOR, NPN Silicon 2N3646	48-84305A20	101369	2
Q4	TRANSISTOR, NPN Silicon 2N3904	48-84066A57	101377	1
Q5	Same as Q3			
Q6	TRANSISTOR, PNP Silicon 2N3906	48-83358H10	101378	1
R1	RESISTOR, CC 33 k 5%, 1/4W	6-124A85	101576	1
R2	RESISTOR, CC 100 Ω 5%, 1/4W	6-124A25	101609	4
R3	RESISTOR, CC 100 k 5%, 1/4W	6-124A97	101558	3
R4	RESISTOR, CC 1 k 5%, 1/4W	6-124A49	101569	8
R5	Same as R4			
R6	Same as R2			
R7	RESISTOR, CC 56 Ω 5%, 1/4W	6-124A19	101735	3
R8	Same as R7			
R9	RESISTOR, CC 10 k 5%, 1/4W	6-124A73	101570	5
R10	Same as R9			

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A6, SOURCE 3 PC ASSEMBLY #1-82822K88 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S–D PART NO.	QTY PER ASSY
R11	RESISTOR, CC 3.3 k 5%, 1/4W	6-124A61	101559	1
R12	RESISTOR, CC 1.2 k 5%, 1/4W	6-124A51	101581	1
R13	RESISTOR, CC 470 Ω 5%, 1/4W	6-124A41	101625	3
R14	Same as R2			
R15	Same as R7			
R16	Same as R9			
R17	RESISTOR, CC 4.7 k 5%, 1/4W	6-124A65	101598	6
R18	Same as R13			
R19	RESISTOR, CC 1.5 k 5%, 1/4W	6-124A53	101577	1
R20	Same as R13			
R21	Same as R9			
R22	RESISTOR, CC 220 Ω 5%, 1/4W	6-124A33	101566	2
R23	RESISTOR, CC 2.7 k 5%, 1/4W	6-124A59	101599	2
R24	RESISTOR, CC 2 k 5%, 1/4W	6-124A25	101572	1
R25	Same as R17			
R26	Same as R17			
R27	Same as R17			
R28	Same as R17			
R29	Same as R2			
R30	Same as R4			
R31	Same as R4			
R32	Same as R4			
R33	Same as R4			
R34	Same as R17			
R35	Same as R22			
R36	Same as R3			
R37	Same as R4			
R38	Same as R3			
R39	Same as R23			
R40	RESISTOR, CC 270 Ω 5%, 1/4W	6-124A35	101542	2
R41	Same as R40			
R42	Same as R4			
R43	Same as R9			
R44	RESISTOR, CC 39 k 5%, 1/4W	6-124A87	101561	1
TP1	TERMINAL, Swage Test Point	29-80321A65	100496	4
TP2	Same as TP1			
TP3	Same as TP1			
TP4	Same as TP1			
U1	INTEGRATED CIRCUIT, CA3026 Linear Amp	51-80321A67	025724	1
U2	INTEGRATED CIRCUIT, SN76514L MSC Bal Mixer	51-80321A75	045235	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A6, SOURCE 3 PC ASSEMBLY #1-82822K88 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
U3	INTEGRATED CIRCUIT, MC12040L ECL Phase Frequency Detector	51-80321A69	045277	1
U4	INTEGRATED CIRCUIT, CA3130T Operational Amplifier	51-83819K39	103231	1
U5	INTEGRATED CIRCUIT, LM301AH Operational Amplifier	51-84204D30	025745	1
	BOARD, PC		053735	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A8, 400 MHz REFERENCE PC ASSEMBLY #1-82778K18

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
A4A8	ASSEMBLY, 400 MHz Reference (Rev F)	1-82778K18	05566801	REF
C1	CAPACITOR, Ceramic .1 µF 20%, 50V	21-84209D49	100178	2
C2	CAPACITOR, Tant 1 µF 10%, 35V	23-82783B26	100082	2
C3	CAPACITOR, Ceramic .001 µF 20%, 50V	21-82187B14	100251	11
C4	Same as C3			
C5	Same as C3			
C6	Same as C3			
C7	Same as C3			
C8	CAPACITOR, Ceramic 10 pF, 1 kV	21-80321A38	100282	4
C9	CAPACITOR, Ceramic 15 pF 5%, 1 kV	21-80321A37	100355	1
C10	Same as C8			
C11	CAPACITOR, Ceramic 100 pF 10%, 100V	21-865391	102856	1
C12	CAPACITOR, Tant 10 µF 10%, 20V	23-82783B27	100063	2
C13	CAPACITOR, Ceramic .01 µF +80-20%, 100V	21-84309A25	100103	2
C14	Same as C3			
C15	Same as C3			
C16	Same as C13			
C17	Same as C8			
C18	CAPACITOR, DM 100 pF 5%, 500V	21-84309A44	100173	2
C19	Same as C2			
C20	Same as C18			
C21	CAPACITOR, CM 10 pF 5%, 500V	21-859934	100253	1
C22	Same as C8			
C23	Same as C3			
C24	CAPACITOR, Tant 4.7 µF 10%, 10V	23-84309A32	100205	1
C25	CAPACITOR, DM 47 pF 5%, 500V	21-868681	100171	1
C26	Same as C12			
C27	CAPACITOR, DM 56 pF 5%, 500V	21-84309A28	100179	1
C28	Same as C1			
C29	Same as C3			
C30	Same as C3			
C31	Same as C3			
C32	CAPACITOR, Ceramic 1 µF 20%, 50V	21-84208D96	100176	1
C33	CAPACITOR, Chip .056 pF 100V	21-84309A23	100257	3
C34	Same as C33			
C35	Same as C33			
CR1	DIODE, Varicap SNV1266	48-84204D08	100453	1
CR2	DIODE, Pin 5082-3188	48-80321A01	103338	2
CR3	Same as CR2			
CR4	DIODE, Signal 50V 1N4151	48-84309A57	100385	2
CR5	Same as CR4			

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A8, 400 MHz REFERENCE #1-82778K18 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
J1	RECEPTICAL, RF Jack	9-80321A46	103173	1
L1	INDUCTOR, Fixed	24-80321A29	05399501	1
L2	INDUCTOR, Fixed 2.7 µH 10%	24-84204D55	101299	3
L3	Same as L2			
L4	INDUCTOR, Fixed 470 µH 5%	24-84309A91	101297	1
L5	WIRE LOOP			2
L6	Same as L5			
L7	INDUCTOR, Fixed 100 µH 5%	24-84309A90	101306	1
L8	Same as L2			
Q1	TRANSISTOR, NPN Silicon 2N3643	48-83227D08	101358	1
Q2	TRANSISTOR, MOSFET N-Channel SPF759	48-84204D20	101416	1
Q3	TRANSISTOR, NPN Silicon 2N3563	48-80330A80	102696	1
Q4	TRANSISTOR, NPN Silicon 2N3904	48-84066A57	101377	1
Q5	TRANSISTOR, PNP Silicon 2N3645	48-84307A21	101367	1
Q6	TRANSISTOR, NPN Silicon 2N3646	48-84305A20	101369	1
R1	RESISTOR, CC 10 k 5%, 1/4W	6-124A73	101570	8
R2	RESISTOR, CC 56 k 5%, 1/4W	6-124A91	101670	1
R3	RESISTOR, CC 33 k 5%, 1/4W	6-124A85	101576	1
R4	RESISTOR, CC 22 Ω 5%, 1/4W	6-124A09	101696	1
R5	RESISTOR, CC 470 Ω 5%, 1/4W	6-124A11	101625	4
R6	Same as R1			
R7	Same as R1			
R8	Same as R5			
R9	Same as R5			
R10	Same as R1			
R11	Same as R1			
R12	Same as R1			
R13	RESISTOR, CC 100 Ω 5%, 1/4W	6-124A25	101609	4
R14	Same as R13			
R15	RESISTOR, CC 4.7 k 5%, 1/4W	6-124A65	101598	1
R16	Same as R5			
R17	Not Used			
R18	RESISTOR, CC 1 M 5%, 1/4W	6-124B22	101605	2
R19	Same as R1			
R20	Same as R1			
R21	Same as R13			
R22	Same as R18			
R23	RESISTOR, CC 1 k 5%, 1/4W	6-124A49	101569	6
R24	RESISTOR, JC 56 Ω 5%, 1/4W	6-124A19	101735	1
R25	RESISTOR, CC 220 Ω 5%, 1/4W	6-124A33	101566	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A8, 400 MHz REFERENCE #1-82778K18 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
R26	Same as R13			
R27	Same as R23			
R28	Same as R23			
R29	Same as R23			
R30	Same as R23			
R31	Same as R23			
TP1	Not Used			
TP2	TERMINAL, Swage	29-80321A65	100496	1
U1	INTEGRATED CIRCUIT, 11C90DC ECL MSI Divide-By-10	51-80321A71	103416	1
U2	INTEGRATED CIRCUIT, SN74S112N TTL SSI Dual J-K Flip Flop	51-84810F04	025786	1
U3	INTEGRATED CIRCUIT, SN7490N TTL MSI Decade Counter	51-84309A76	025732	1
U4	INTEGRATED CIRCUIT, MC4044P TTL MSI Phase Frequency	51-84688D29	045238	1
U5	INTEGRATED CIRCUIT, CA3130T Operational Amplifier	51-83819K39	103231	1
	FINGERSTOCK	39-80332A22	055861	2
	BOARD, PC		055668	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A9, LOGIC PC ASSEMBLY #1-82778K20

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
A4A9	ASSEMBLY, Logic PC (Rev C)	1-82778K20	05567101	REF
CR1	DIODE, Signal 50V 1N415	48-84309A57	100385	1
Q1	TRANSISTOR, PNP Silicon 2N4249	48-84305A08	102719	13
Q2	Same as Q1			
Q3	Same as Q1			
Q4	Same as Q1			
Q5	Same as Q1			
Q6	Same as Q1			
Q7	Same as Q1			
Q8	Same as Q1			
Q9	Same as Q1			
Q10	Same as Q1			
Q11	Same as Q1			
Q12	Same as Q1			
Q13	Same as Q1			
R1	RESISTOR, CC 100 k 5%, 1/4W	6-124A97	101558	26
R2	Same as R1			
R3	Same as R1			
R4	RESISTOR, CC 33 k 5%, 1/4W	6-124A85	101576	12
R5	Same as R1			
R6	Same as R1			
R7	Same as R4			
R8	Same as R1			
R9	Same as R1			
R10	Same as R4			
R11	Same as R1			
R12	Same as R4			
R13	Same as R1			
R14	Same as R1			
R15	Same as R1			
R16	Same as R1			
R17	Same as R1			
R18	Same as R4			
R19	Same as R1			
R20	Same as R4			
R21	Same as R1			
R22	Same as R1			
R23	Same as R1			
R24	Same as R4			
R25	Same as R1			

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION — A4A9, LOGIC PC ASSEMBLY #1-82778K20 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S—D PART NO.	QTY PER ASSY
R26	Same as R4			
R27	Same as R1			
R28	Same as R1			
R29	Same as R4			
R30	Same as R1			
R31	Same as R1			
R32	Same as R1			
R33	Same as R1			
R34	Same as R4			
R35	Same as R1			
R36	Same as R1			
R37	Same as R4			
R38	Same as R4			
U1	INTEGRATED CIRCUIT, MC14560P COMS NBCD Adder	51-80321A75	103433	3
U2	Same as U1			
U3	Same as U1			
U4	INTEGRATED CIRCUIT, SN74LS75 TTL MSI Quad Latch	51-80330A75	103133	3
U5	Same as U4			
U6	Same as U4			
U7	INTEGRATED CIRCUIT, MC3002P TTL SSI Quad 2-Input NOR Gate	51-84209D29	025739	1
U8	INTEGRATED CIRCUIT, SN7408N TTL SSI Quad 2-Input AND Gate	51-84084D20	103093	2
U9	Same as U8			
U10	INTEGRATED CIRCUIT, SN7432N TTL SSI Quad 2-Input OR Gate	51-84084D74	045257	1
U11	INTEGRATED CIRCUIT, SN7400N TTL SSI Quad 2-Input NAND Gate	51-84309A73	019705	1
U12	INTEGRATED CIRCUIT, MC3021P TTL SSI Quad 2-Input Excl OR Gate	51-84209D61	025789	1
U13	INTEGRATED CIRCUIT, SN7442N TTL MSI BCD-Decimal Decoder	51-84084D09	025749	1
	BOARD, PC		055671	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A10, DIVIDE-BY-N PC ASSEMBLY #1-82778K19

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
A4A10	ASSEMBLY, Divide-By-N PC (Rev D)	1-82778K19	05567001	REF
C1	CAPACITOR, Ceramic 1000 pF 20%, 50V	21-82187B14	100251	8
C2	CAPACITOR, Ceramic .01 µF +80-20%, 100V	21-84309A25	100103	2
C3	CAPACITOR, DM 10 pF 5%, 500V	21-84309A41	100253	2
C4	CAPACITOR, DM 100 pF 5%, 500V	21-84309A44	100173	2
C5	CAPACITOR, Varcer, 9.0-35 pF	20-84209D87	100159	1
C6	Same as C3			
C7	Same as C4			
C8	CAPACITOR, DM 47 pF 5%, 500V	21-868681	100171	1
C9	Same as C2			
C10	Same as C1			
C11	Same as C1			
C12	Same as C1			
C13	Same as C1			
C14	CAPACITOR, Tant 39 F 10%, 10V	23-82783B36	100183	2
C15	Same as C14			
C16	Same as C1			
C17	CAPACITOR, Ceramic .1 F 20%, 50V	21-84209D49	100178	3
C18	Same as C17			
C19	Same as C17			
C20	Same as C1			
C21	Same as C1			
CR1	DIODE, Signal 50V 1N4151	48-84309A57	100385	4
CR2	Same as CR1			
CR3	Same as CR1			
CR4	Same as CR1			
J1	RECEPTICAL, RF Jace	9-80321A46	103173	1
L1	INDUCTOR, Fixed 1 µH 5%	24-84204D58	101303	1
R1	RESISTOR, CC 470 Ω 5%, 1/4W	6-124A41	101625	12
R2	Same as R1			
R3	Same as R1			
R4	Same as R1			
R5	Same as R1			
R6	Same as R1			
R7	Same as R1			
R8	Same as R1			
R9	Same as R1			
R10	Same as R1			

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A10, DIVIDE-BY-N PC ASSEMBLY #1-82778K19 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
R11	RESISTOR, CC 1 k 5%, 1/4W	6-124A49	101569	2
R12	RESISTOR, CC 2.2 k 5%, 1/4W	6-124A57	101562	1
R13	Same as R1			
R14	RESISTOR, CC 1.5 k 5%, 1/4W	6-124A53	101577	1
R15	RESISTOR, CC 1 M 5%, 1/4W	6-124B22	101605	2
R16	RESISTOR, CC 10 k 5%, 1/4W	6-124A73	101570	2
R17	Same as R16			
R18	Same as R15			
R19	RESISTOR, CC 51 Ω 5%, 1/4W	6-124A18	101672	1
R20	Same as R1			
R21	Same as R11			
TP1	TERMINAL, Swage	39-80321A65	100496	4
TP2	Same as TP1			
TP3	Same as TP1			
TP4	Same as TP1			
U1	INTEGRATED CIRCUIT, 11C90DC ECL MSI Div 10/11, 600 MHz	51-80321A71	103416	1
U2	INTEGRATED CIRCUIT, MC10137L ECL Sync Counter	51-80321A73	103027	3
U3	INTEGRATED CIRCUIT MC10106P ECL SSI 4-3-3 Input NOR Gate	51-80321A74	103168	1
U4	Same as U2			
U5	INTEGRATED CIRCUIT MC10131L ECL Dual D Flip-Flop	51-80321A91	045239	1
U6	Same as U2			
U7	INTEGRATED CIRCUIT, SN74S132N TTL SSI Quad 2-INput NAND Gate	51-84209D60	045271	1
U8	INTEGRATED CIRCUIT, MC4044P TTL MSI Phase Frequency Detector	51-84688D29	045238	1
U9	INTEGRATED CIRCUIT, CA3130T Selected Operational Amplifier	51-83819K39	067036	1
U10	INTEGRATED CIRCUIT, MC10125L ECL Quad Translator	51-80321A72	045226	1
	HEATSINK	7-80321A81	103224	3
	BOARD, PC		055670	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A11, SOURCE 4 PC ASSEMBLY #1-82822K89

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
A4A11	ASSEMBLY, Source 4 PC (Rev J)	1-82822K89	05372401	REF
C1	CAPACITOR, Ceramic .001 µF 20%, 50V	21-82187B14	100251	8
C2	Same as C1			
C3	Same as C1			
C4	Same as C1			
C5	CAPACITOR, Tant 39 µF 10%, 20V	23-84309D30	102561	1
C6	CAPACITOR, Tant 100 µF 10%, 20V	23-83819K65	100208	1
C7	Same as C1			
C8	Not Used			
C9	Not Used			
C10	CAPACITOR, DM 1000 pF 5%, 100V	21-84309A47	100243	1
C11	CAPACITOR, DM 56 pF 5%, 500V	21-84309A28	100179	1
C12	Same as C1			
C13	Same as C1			
C14	Same as C1			
C15	CAPACITOR, Ceramic 1 µF 20%, 50V	21-84208D96	100176	1
C16	CAPACITOR, DM 220 pF 5%, 500V	21-84309A33	100220	1
CR1	DIODE, Varicap 250 pF KV1701	48-84204D07	100452	2
CR2	Same as CR1			
CR3	DIODE, Varicap 10.85 pF SMV1266	48-84204D08	100453	8
CR4	Same as CR3			
CR5	Same as CR3			
CR6	Same as CR3			
CR7	Same as CR3			
CR8	Same as CR3			
CR9	Same as CR3			
CR10	Same as CR3			
CR11	DIODE, Pin 5082-3188	48-80321A01	103338	6
CR12	Same as CR11			
CR13	Same as CR11			
CR14	Same as CR11			
CR15	Same as CR11			
CR16	Same as CR11			
J1	RECEPTICAL, RF Jack	9-80321A46	103173	2
J2	Same as J2			
L1	INDUCTOR, Fixed 10 µH 10%	24-84024D61	101317	1
L2	INDUCTOR, Fixed 2.2 µH 10%	24-80321A21	101309	9
L3	INDUCTOR, 1-1/2 Turns, #22 ga	24-80329A99	05399507	2
L4	Same as L3			
L5	Same as L2			

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A11, SOURCE 4 PC ASSEMBLY #1-82822K89 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
L6	Same as L2			
L7	INDUCTOR, 1-1/2 Turns, #22 ga	24-80321A29	05399501	2
L8	Same as L7			
L9	Same as L2			
L10	Same as L2			
L11	INDUCTOR, 3-1/2 Turns, #22 ga	24-80321A25	05399503	1
L12	Same as L2			
L13	Same as L2			
L14	Same as L2			
L15	INDUCTOR, 1-1/2 Turns, #22 ga	24-80332A01	05399508	1
L16	Same as L2			
L17	INDUCTOR, Fixed 470 µH 10%	24-84204D62	101321	2
L18	Same as L17			
Q1	TRANSISTOR, MOSFET N-Channel SPF759	48-84204D20	101416	4
Q2	TRANSISTOR, PNP Silicon 2N3906	48-83358H10	101378	6
Q3	TRANSISTOR, NPN Silicon 2N3904	48-84066A57	101377	5
Q4	Same as Q1			
Q5	Same as Q1			
Q6	Same as Q3			
Q7	Same as Q1			
Q8	Same as Q2			
Q9	Same as Q3			
Q10	Same as Q1			
Q11	Same as Q2			
Q12	Same as Q3			
Q13	Same as Q2			
Q14	Same as Q2			
Q15	Same as Q3			
R1	RESISTOR, CC 56 k 5%, 1/4W	6-124A91	101670	2
R2	RESISTOR, CC 33 k 5%, 1/4W	6-124A85	101576	2
R3	RESISTOR, CC 1 k 5%, 1/4W	6-124A49	101569	4
R4	RESISTOR, CC 4.7 k 5%, 1/4W	6-124A65	101598	5
R5	RESISTOR, CC 10 Ω 5%, 1/4W	6-124A01	101557	2
R6	RESISTOR, CC 10 k 5%, 1/4W	6-124A73	101570	15
R7	Same as R6			
R8	Same as R6			
R9	RESISTOR, CC 1.2 k 5%, 1/4W	6-124A51	101581	1
R10	RESISTOR, CC 56 k 5%, 1/8W	6-185A91	101823	2
R11	RESISTOR, CC 33 k 5%, 1/8W	6-185A85	101693	2
R12	Same as R3			
R13	RESISTOR, CC 10 k 5%, 1/8W	6-185A73	101697	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A11, SOURCE 4 PC ASSEMBLY #1-82822K89 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S—D PART NO.	QTY PER ASSY
R14	Same as R6			
R15	Same as R6			
R16	Same as R1			
R17	Same as R2			
R18	Same as R3			
R19	Same as R6			
R20	Same as R6			
R21	Same as R6			
R22	Same as R10			
R23	Same as R11			
R24	Same as R6			
R25	Same as R6			
R26	Same as R5			
R27	Not Used			
R28	Same as R4			
R29	Not Used			
R30	Not Used			
R31	Same as R4			
R32	RESISTOR, CC 220 Ω 5%, 1/4W	6-124A33	101566	1
R33	RESISTOR, CC 100 Ω 5%, 1/4W	6-6-124A25	101609	1
R34	RESISTOR, CC 56 Ω 5%, 1/4W	6-124A19	101735	3
R35	Same as R4			
R36	Same as R6			
R37	Same as R6			
R38	Same as R6			
R39	Same as R6			
R40	Same as R6			
R41	Same as R3			
R42	Not Used			
R43	Sane as R4			
R44	Same as R34			
R45	Not Used			
R46	Not Used			
R47	Not Used			
R48	Not Used			
R49	Not Used			
R50	Same as R34			
TP1	TERMINAL, Swage	29-80321A65	100496	1
U2	INTEGRATED CIRCUIT, SAM-2 Mixer	51-82778K08	102815	1
U3	INTEGRATED CIRCUIT, Op Amp ATF-417	51-80312A92	103012	1
	BOARD, PC		053724	1
	FINGERSTOCK	39-80332A22	055861	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A12, PHASE DETECTOR PC ASSEMBLY #1-82822K94

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
A4A12	ASSEMBLY, Phase Detector PC (Rev G)	1-82822K94	05538501	REF
C1	CAPACITOR, Ceramic .1 µF 20%, 50V	21-84209D42	100178	7
C2	Same as C1			
C3	Same as C1			
C4	Same as C1			
C5	Same as C1			
C6	CAPACITOR, Ceramic .01 µF +80-20%, 100V	21-84309A25	100103	14
C7	Same as C6			
C8	Same as C6			
C9	Same as C6			
C10	Same as C6			
C11	CAPACITOR, DM 220 pF 5%, 500V	21-84309A33	100220	2
C12	CAPACITOR, DM 330 pF 5%, 500V	21-837267	100276	1
C13	CAPACITOR, Ceramic 1 µF 20%, 50V	21-84208D96	100176	2
C14	Same as C13			
C15	Same as C6			
C16	Same as C6			
C17	Same as C6			
C18	Same as C6			
C19	Same as C6			
C20	Same as C11			
C21	Same as C6			
C22	CAPACITOR, DM 150 pF 5%, 500V	21-840047	100219	1
C23	CAPACITOR, Tant 1 µF 10%, 35V	23-82783B26	100082	4
C24	Same as C23			
C25	Same as C6			
C26	CAPACITOR, DM 470 pF 5%, 300V	21-82537B06	100221	1
C27	Same as C1			
C28	Same as C6			
C29	Same as C23			
C30	Same as C6			
C31	Not Used			
C32	Not Used			
C33	Not Used			
C34	Same as C23			
C35	CAPACITOR, DM 47 pF 5%, 500V	21-868681	100171	1
C36	CAPACITOR, Ceramic 1000 pF 20%, 50V	21-82187B14	100251	1
C37	Same as C1			
CR1	DIODE, Signal 50V 1N4151	48-84309A57	100385	8
CR2	Same as CR1			
CR3	Same as CR1			

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A12, PHASE DETECTOR #1-82822K94 (Cont'd)

REF #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
CR4	Same as CR1			
CR5	Same as CR1			
CR6	Same as CR1			
CR7	Same as CR1			
CR8	Same as CR1			
L1	INDUCTOR, Fixed .47 µH 20%	24-80321A28	101318	2
L2	Same as L1			
L3	INDUCTOR, Fixed 6.8 µH 10%	24-84204D56	101300	1
L4	INDUCTOR, Fixed 1 µH 5%	24-84204D58	101303	2
L5	Same as L4			
Q1	TRANSISTOR, NPN Silicon	48-84066A57	101377	1
R1	RESISTOR, CC 56 Ω 5%, 1/4W	6-124A19	101735	4
R2	RESISTOR, CC 100 Ω 5%, 1/4W	6-124A25	101609	5
R3	Same as R2			
R4	RESISTOR, CC 100 k 5%, 1/4W	6-124A97	101558	2
R5	RESISTOR, CC 150 k 5%, 1/4W	6-124B02	101604	1
R6	Same as R2			
R7	RESISTOR, CC 470 Ω 5%, 1/4W	6-124A41	101625	1
R8	RESISTOR, CC 1 M 5%, 1/4W	6-124B22	101605	1
R9	RESISTOR, CC 4.7 k 5%, 1/8W	6-185A65	101792	1
R10	RESISTOR, CC 1 k 5%, 1/8W	6-185A49	101711	3
R11	Same as R10			
R12	Same as R10			
R13	RESISTOR, CC 4.7 k 5%, 1/4W	6-124A65	101598	3
R14	Same as R1			
R15	RESISTOR, CC 10 k 5%, 1/4W	6-124A73	101570	5
R16	RESISTOR, CC 1 k 5%, 1/4W	6-124A49	101569	1
R17	RESISTOR, CC 22 k 5%, 1/8W	6-185A81	101797	1
R18	RESISTOR, CC 22 k 5%, 1/4W	6-124A81	101572	1
R19	Same as R15			
R20	RESISTOR, CC 5o k 5%, 1/4W	6-125A91	101670	3
R21	RESISTOR, Variable 10 k 10%, 3/8W	18-84209D26	102472	2
R22	Same as R1			
R23	RESISTOR, CC 270 Ω 5%, 1/4W	6-124A35	101542	1
R24	Same as R22			
R25	Same as R20			
R26	Same as R13			
R27	Same as R13			
R28	Same as R2			
R29	Same as R8			
R30	RESISTOR, CC 470 Ω 5%, 1 8W	6-185A41	101709	4

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A12, PHASE DETECTOR #1-82822K94 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
R31	Not Used			
R32	Not Used			
R33	Same as R30			
R34	Same as R30			
R35	Same as R30			
R36	Same as R2			
R37	Same as R15			
R38	Same as R21			
R39	Same as R1			
R40	Same as R15			
R41	Same as R15			
TP1	TERMINAL, Swage	29-80321A65	100496	4
TP2	Same as TP1			
TP3	Same as TP1			
TP4	Same as TP1			
U1	INTEGRATED CIRCUIT, MC1590G ECL Linear Amp	51-84204D38	025788	2
U2	Same as U1			
U3	INTEGRATED CIRCUIT, MC10115L ECL Quad LIne Receiver	51-80321A68	045254	1
U4	INTEGRATED CIRCUIT, MC12040L ECL Phase Frequency Detector	51-80321A69	045277	1
U5	INTEGRATED CIRCUIT, LM301AH Operational Amplifier	51-84204D30	025745	4
U6	Same as U5			
U7	Same as U5			
U8	Same as U5			
U9	INTEGRATED CIRCUIT, CA3130T	51-83819K39	103231	1
	BOARD, PC		055385	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A13, SOURCE 5 PC ASSEMBLY #1-80307A65

REF. #	DESCRIPTION	MOTOROLA PART NO.	S–D PART NO.	QTY PER ASSY
A4A13	ASSEMBLY, Source 5 PC (Rev B)	1-80307A65	05797001	REF
C1	CAPACITOR, Disc .01 µF +80-20%, 100V	21-84309A25	100103	1
C2	CAPACITOR, DM 50 pF 5%, 500V	21-80321A40	102549	1
C3	CAPACITOR, Disc, 33 pF 10%, 1 kV	21-84205D39	100054	3
C4	CAPACITOR, Disc, 10 pF, 1 kV	21-80321A38	100282	3
C5	CAPACITOR, Disc, 15 pF 5%, 1 kV	21-80321A37	100355	6
C6	Same as C3			
C7	Same as C5			
C8	Same as C4			
C9	CAPACITOR, Mold .001 µF 20%, 50V	21-82187B14	100251	12
C10	Same as C9			
C11	Same as C5			
C12	Same as C3			
C13	Same as C5			
C14	Same as C5			
C15	Same as C9			
C16	Same as C5			
C17	Same as C4			
C18	Same as C9			
C19	Same as C9			
C20	Same as C9			
C21	Same as C9			
C22	Same as C9			
C23	Same as C9			
C24	Same as C9			
C25	Same as C9			
C26	CAPACITOR, Tant 4.7 µF 10%, 20V	23-82783B11	100071	1
C27	CAPACITOR, Tant 39 µF 10%, 20V	23-84309D30	102561	2
C28	CAPACITOR, Chip 5000 pF 125V	21-84205D41	100297	4
C29	Same as C28			
C30	Same as C28			
C31	CAPACITOR, Disc, .1 µF 20%, 50V	21-84209D49	100178	1
C32	Same as C9			
C33	Same as C28			
C34	Same as C27			
C35	CAPACITOR, Disc, 5 pF 5%, 500V	21-871966	117418	1
CR1	DIODE, Signal 1N4830	48-84305A17	100440	2
CR2	DIODE, Vericap KV1710	48-84204D07	100452	2
CR3	Same as CR2			
CR4	DIODE, Pin HP5082-3188	48-80321A01	103338	8
CR5	Same as CR4			

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION — A4A13, SOURCE 5 PC ASSEMBLY #1-80307A65

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
CR6	DIODE, Cap SMV-1266	48-84204D08	100453	12
CR7	Same as CR6			
CR8	Same as CR6			
CR9	Same as CR6			
CR10	Same as CR6			
CR11	Same as CR6			
CR12	Not Used			
CR13	Not Used			
CR14	Not Used			
CR15	Not Used			
CR16	Not Used			
CR17	Not Used			
CR18	Same as CR4			
CR19	Same as CR4			
CR20	Same as CR4			
CR21	Same as CR4			
CR22	Same as CR4			
CR23	Same as CR4			
CR24	DIODE, Pin 47688	48-84204D04	100447	2
CR25	Same as CR24			
CR26	Same as CR1			
J1	JACK, Receptical	9-80321A46	103173	2
J2	Same as J1			
L1	INDUCTOR, Fixed 11/64 ID 22 GA	24-80329A99	05399507	2
L2	Same as L1			
L3	INDUCTOR, Fixed 1/8 ID 22 GA	24-80321A29	05399501	4
L4	Same as L3			
L5	INDUCTOR, Fixed 1/8 ID 22 GA	24-80321A25	05399503	1
L6	Not Used			
L7	Not Used			
L8	Same as L3			
L9	Same as L3			
L10	Not Used			
L11	NOt Used			
L12	INDUCTOR, Fixed, .06 µH 10%	24-84209D02	101322	6
L13	Same as L12			
L14	INDUCTOR, Fixed, .05 µH 10%	24-84309A87	101323	2
L15	Same as L14			
L16	INDUCTOR, Fixed 10 µH 10%	24-84204D61	101317	1
L17	INDUCTOR, Fixed 2.2 µH 10%	24-80321A21	101309	7
L18	Same as L17			

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A13, SOURCE 5 PC ASSEMBLY #1-80307A65 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
L19	Same as L17			
L20	Same as L17			
L21	Same as L12			
L22	Same as L12			
L23	Same as L12			
L24	Same as L12			
L25	Same as L17			
L26	Same as L17			
L27	Same as L17			
Q1	TRANSISTOR, MOSFET N-Channel SPF759	48-84204D20	101416	3
Q2	Same as Q1			
Q3	Same as Q1			
Q4	Not Used			
Q5	Not Used			
Q6	TRANSISTOR, PNP Silicon 2N2906	48-83358H10	101378	6
Q7	Same as Q6			
Q8	Same as Q6			
Q9	Same as Q6			
Q10	Same as Q6			
Q11	Same as Q6			
Q12	Not Used			
Q13	TRANSISTOR, NPN Silicon 2N3904	48-84066A57	101377	6
Q14	Same as Q13			
Q15	Same as Q13			
Q16	Same as Q13			
Q17	Same as Q13			
Q18	Same as Q13			
R1	RESISTOR, CC 33 k 5%, 1/4W	6-124A85	101576	1
R2	RESISTOR, CC 56 k 5%, 1/8W	6-185A91	101823	3
R3	RESISTOR, CC 68 Ω 5%, 1/8W	6-185A21	101700	3
R4	RESISTOR, CC 100 k 5%, 1/8W	6-185A98	101976	1
R5	Not Used			
R6	RESISTOR, CC 100 k 5%, 1/4W	6-124A97	101558	2
R7	Same as R6			
R8	Same as R2			
R9	RESISTOR, CC 33 k 5%, 1/8W	6-185A85	101693	2
R10	RESISTOR, CC 1 k 5%, 1/4W	6-124A49	101569	8
R11	Same as R3			
R12	Same as R2			
R13	Same as R1			
R14	Same as R10			
R15	Same as R3			

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION: A4A13, SOURCE 5 PC ASSEMBLY #1-80307A65 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
R16	Same as R10			
R17	Not Used			
R18	RESISTOR, CC 680 Ω 5%, 1/4W	6-124A45	101669	2
R19	RESISTOR, CC 3.9 k 5%, 1/4W	6-124A63	101601	1
R20	RESISTOR, CC 470 Ω 5%, 1/4W	6-124A41	101625	2
R21	Same as R10			
R22	Same as R10			
R23	Not Used			
R24	RESISTOR, CC 2.7 k 5%, 1/4W	6-124A59	101599	3
R25	Same as R18			
R26	Same as R24			
R27	RESISTOR, CC 220 Ω 5%, 1/4W	6-124A33	101566	2
R28	Same as R10			
R29	RESISTOR, CC 10 k 5%, 1/4W	6-124A73	101570	8
R30	Same as R24			
R31	RESISTOR, CC 56 Ω 5%, 1/4W	6-124A19	101735	2
R32	RESISTOR, CC 100 Ω 5%, 1/8W	6-185A25	101701	1
R33	RESISTOR, CC 10 k 5%, 1/8W	6-185A73	101697	12
R34	Same as R33			
R35	Same as R33			
R36	Same as R33			
R37	Same as R33			
R38	Same as R33			
R39	Same as R33			
R40	Same as R33			
R41	Same as R33			
R42	RESISTOR, CC 1.2 k 5%, 1/4W	6-124A51	101581	3
R43	Same as R33			
R44	Same as R33			
R45	Same as R33			
R46	Same as R42			
R47	Not Used			
R48	Same as R29			
R49	Same as R29			
R50	Same as R29			
R51	Same as R42			
R52	Same as R29			
R53	Same as R29			
R54	Same as R29			
R55	RESISTOR, CC 10 Ω 5%, 1/4W	6-124A01	101557	2
R56	Same as R10			
R57	Same as R20			

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A13, SOURCE 5 PC ASSEMBLY #180307A65 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
R58	Same as R10			
R59	Same as R55			
R60	RESISTOR, CC 47 Ω 5%, 1/4W	6-124A17	101560	1
U1	INTEGRATED CIRCUIT Dual Oscillator Assembly	51-80330A76	06704301	1
XU1	SOCKET, IC 24-pin	9-84881F02	103845	5
	BOARD, PC		057970	1
	RIVET	5-1653	100924	5
	FINGERSTOCK	39-80332A22	055861	2

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A14, AMPLIFIER PC ASSEMBLY #1-82822K91

REF. #	DESCRIPTION	MOTOROLA PART NO.	S–D PART NO.	QTY PER ASSY
A4A14	ASSEMBLY, Amplifier PC (Rev M)	1-82822K91	05392901	REF
C1	CAPACITOR, Chip .005 µF, 125V	21-84205D41	100297	5
C2	Same as C1			
C3	Same as C1			
C4	Factory Selected			
C5	Same as C1			
C6	CAPACITOR, Tant 1 µF 10%, 35V	23-82783B26	100082	5
C7	CAPACITOR, DM 2 pF, 500V	21-84209D38	102542	2
C8	Same as C7			
C9	CAPACITOR, Ceramic .001 µF 20%, 50V	21-82187B14	100251	4
C10	Same as C1			
C11	Same as C9			
C12	CAPACITOR, Chip 22 pF 5%, 100V	21-80321A41	100263	1
C13	CAPACITOR, DM 27 pF 500V	21-83107B09	100321	2
C14	Same as C6			
C15	CAPACITOR, Ceramic 100 pF 10%, 1 kV	21-80312A95	100045	1
C16	CAPACITOR, DM 220 pF 5%, 500V	21-859942	100220	1
C17	Same as C6			
C18	CAPACITOR, Tant 10 µF 10%, 20V	23-82783B27	100063	1
C19	Same as C13			
C20	Factory Selected			
C21	Factory Selected			
C22	Factory Selected			
C23	CAPACITOR, Chip 5.1 pF, 100V	21-84209D48	100270	1
C24	CAPACITOR, Ceramic 1 µF 20%, 50V	21-84208D96	100176	1
C25	CAPACITOR, DM 33 pF 5%, 500V	21-847772	100175	1
C26	Same as C6			
C27	CAPACITOR, Tant 180 µF 10%, 6V	23-80321A32	100207	1
C28	Same as C6			
C29	CAPACITOR, Chip .056 µF 20%, 100V	21-84309A23	100257	1
C30	Same as C9			
C31	Factory Selected			
C32	Factory Selected			
C33	Factory Selected			
C34	Factory Selected			
C35	Factory Selected			
C36	CAPACITOR, Ceramic .01 µF +80-20%, 100V	21-84309A25	100103	2
C37	CAPACITOR, Tant 330 µF 20%, 6V	23-83739K55	100188	1
C38	Not Used			
C39	CAPACITOR, Ceramic 10 pF 1 kV	21-80321A38	100282	2
C40	Same as C39			

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A14, AMPLIFIER PC ASSEMBLY #1-82822K91 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
C41	Same as C36			
C42	Not Used			
C43	Not Used			
C44	Same as C9			
CR1	DIODE, Pin MA-47688	48-84204D04	100447	5
CR2	Same as CR1			
CR3	Same as CR1			
CR4	Same as CR1			
CR5	DIODE, Signal 5082-2800	48-84309A58	100442	3
CR6	DIODE, REctifier 1N4005	48-82466H18	100413	1
CR7	Same as CR1			
CR8	DIODE, Detector, 5082-2787	48-80330A81	117307	1
CR9	Same as CR5			
CR10	Same as CR5			
CR11	DIODE, Signal 50V, 1N4151	48-84309A57	100385	5
CR12	Same as CR11			
CR13	Same as CR11			
CR14	Same as CR11			
CR15	Same as CR11			
J1	RECEPTICAL, RF Jack	9-80321A46	103173	4
J2	Same as J1			
J3	Same as J1			
J4	Same as J1			
K1	ASSEMBLY, Relay	1-80307A91	055890	1
	RELAY, RF Auz, 26.5V P/O K1	80-84092F01	101291	1
L1	INDUCTOR, 1/2 Turn 22 GA	24-80321A26	05399504	2
L2	Same as L1			
L3	INDUCTOR, 8-1/2 Turns 22 GA	24-80321A22	05399505	1
L4	INDUCTOR, Fixed 2.2 µH 10%	24-80321A21	101309	2
L5	Same as L4			
L6	INDUCTOR, Fixed .06 µH 10%	24-84209D02	101322	2
L7	Same as L6			
L8	INDUCTOR, Fixed 1.0 mH 5%	24-84204D58	101303	2
L9	Same as L8			
L10	INDUCTOR, Fixed 100 µH 5%	24-84309A90	101306	1
L11	INDUCTOR, Fixed 270 µH 5%	24-84204D57	101302	1
L12	INDUCTOR, Fixed .15 µH 20%	24-84309A89	101304	1
Q1	TRANSISTOR, NPN Silicon 2N3906	48-83358H10	101378	3
Q2	TRANSISTOR, Short Stud BFR94	48-80330A82	055000	1
Q3	TRANSISTOR, NPN Silicon 2N3904	48-84066A57	101377	2
Q4	Same as Q3			
Q5	Same as Q1			

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A14, AMPLIFIER PC ASSEMBLY #1-82822K91 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
Q6	Same as Q1			
Q7	TRANSISTOR, PNP Silicon 2N4258	48-84209D16	102675	1
Q8	TRANSISTOR, PNP Silicon 2N4959	48-80312A93	101391	1
Q9	TRANSISTOR, NPN Silicon BFR95	48-80321A03	103335	1
Q10	TRANSISTOR, NPN Silicon 2N5179	48-84309A61	101388	1
R1	RESISTOR, CC 10 k 5%, 1/4W	6-124A73	101570	3
R2	RESISTOR, CC 4.7 k 5%, 1/4W	6-124A65	101598	2
R3	Same as R1			
R4	RESISTOR, CC 1 k 5%, 1/4W	6-124A49	101569	4
R5	Same as R2			
R6	RESISTOR, CC 10 k 5%, 1/8W	6-185A73	101697	8
R7	Same as R4			
R8	RESISTOR, CC 470 Ω 5%, 1/8W	6-185A41	101709	4
R9	RESISTOR, CC 51 Ω 5%, 1W		106032	1
R10	RESISTOR, CC 56 Ω 5%, 1/8W	6-185A19	101816	4
R11	RESISTOR, CC 33 k 5%, 1/8W	6-185A85	101693	1
R12	RESISTOR, CC 4.7 k 5%, 1/8W	6-185A65	101792	1
R13	Same as R4			
R14	Same as R1			
R15	Same as R6			
R16	Same as R6			
R17	Same as R6			
R18	RESISTOR, CC 100 k 5%, 1/8W	6-185A97	101976	2
R19	RESISTOR, CC 22 k 5%, 1/8W	6-185A81	101797	5
R20	Same as R6			
R21	Same as R6			
R22	Same as R18			
R23	RESISTOR, CC 470 k 5%, 1/8W	6-185B14	101955	1
R24	Same as R19			
R25	RESISTOR, CC 100 Ω 5%, 1/8W	6-185A25	101701	2
R26	Same as R25			
R27	Same as R10			
R28	RESISTOR, CC 270 Ω 5%, 1/8W	6-185A35	101703	1
R29	Same as R6			
R30	RESISTOR, CC 470 Ω 5%, 1/4W	6-124A41	101625	5
R31	Same as R19			
R32	RESISTOR, CC 150 k 5%, 1/8W	6-185B02	101826	1
R33	Same as R19			
R34	Same as R6			
R35	Same as R30			
R36	Same as R10			
R37	RESISTOR, CC 22 k 5%, 1/4W	6-124A81	101572	2

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A14, AMPLIFIER PC ASSEMBLY #1-82822K91 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
R38	RESISTOR, CC 100 Ω 5%, 1/4W	6-124A25	101609	2
R39	Same as R38			
R40	RESISTOR, CC 680 Ω 5%, 1/2W	6-125A45	101475	1
R41	Same as R4			
R42	RESISTOR, MF 487 Ω 1%, 1/4W	6-10621B64	102137	1
R43	RESISTOR, CC 12 Ω 5%, 1/8W	6-185A03	101819	1
R44	RESISTOR, CC 470 Ω 5%, 2W	6-127A41	101847	1
R45	Same as R37			
R46	RESISTOR, CC 56 Ω 5%, 1/4W	6-124A19	101735	1
R47	Same as R30			
R48	RESISTOR, Variable 10 k 10%, 3/8W	18-84209D26	102472	1
R49	RESISTOR, Variable 500 k 10%, 3/8W	18-83819K59	102207	2
R50	Same as R49			
R51	Same as R19			
R52	Same as R30			
R53	Same as R30			
R54	Same as R10			
R55	Same as R8			
R56	Same as R8			
R57	Same as R8			
R58	RESISTOR, CC 270 Ω 5%, 1/8W	6-185A35	101703	1
TP1	TERMINAL, Swage Test Point	29-80321A65	100496	1
U1	INTEGRATED CIRCUIT, ATF-417 Amplifier	51-80321A92	103012	1
U2	INTEGRATED CIRCUIT, LM301AH Operational Amplifier	51-84204D30	025745	3
U3	Same as U2			
U4	INTEGRATED CIRCUIT, SAM-1 Mixer	1-82778K32	102911	1
U5	Same as U2			
	BOARD, PC		053929	1
	FINGERSTOCK	39-80332A22	055861	1
	TERMINAL, Swage	29-84209D52	100508	3
	SCREW, PHMS 4-40 x 5/16	3-80311A21	10062605	2
	NUT, Kep 4-40	2-80311A16	100941	2
	INSULATOR, Transistor	14-84309A94	100666	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A15, MOTHER BOARD PC ASSEMBLY #1-82778K28

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
A4A15	ASSEMBLY, Mother Board PC (Rev C)	1-82778K28	05569201	REF
C1	Not Used			
C2	Not Used			
C3	Not Used			
C4	Not Used			
C5	CAPACITOR, Ceramic .1 µF 20%, 50V	21-84209D49	100178	11
C6	Same as C5			
C7	Same as C5			
C8	Same as C5			
C9	CAPACITOR, Chip .056 µF 20%, 100V	21-84309A23	100257	64
C10	Same as C9			
C11 thru C40	Same as C9			
C41	CAPACITOR, Chip 5000 pF, 125V	21-84205D41	100297	4
C42	Same as C41			
C43	Same as C41			
C44	Same as C5			
C45	Same as C5			
C46	Same as C5			
C47	Same as C5			
C48	Not Used			
C49	Not Used			
C50	Same as C9			
C51	Same as C5			
C52	Same as C5			
C53	Same as C5			
C54 thru C69	Same as C9			
C70	Same as C41			
C71	Same as C9			
C72	Same as C9			
C73	Same as C9			
C74	Not Used			
C75	Same as C9			
C76 thru C86	Same as C9			
C87	CAPACITOR, Chip 27 pF 5%, 100V	21-82778K75	100299	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A15, MOTHER BOARD PC ASSEMBLY #1-82778K28 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
J1 thru J14	CONNECTOR, PC Edge	28-80321A55	102806	14
L1 thru L13	INDUCTOR, Fixed 2.2 µH 10%	24-80321A21	101309	15
L14	INDUCTOR, Fixed 2.7 µH 10%, 10	24-84204D65	101327	1
L15	Not Used			
L16	Same as L1			
L17	Same as L1			
L18	INDUCTOR, Factory Selected			1
	BOARD, PC		055692	1
	SCREW, PHMS 2/56 x 3/16	3-80311A72	10062503	8
	WASHER, Split Lock #2	4-400139	100661	8
	WASHER, Flat #2	4-80311A76	100614	8
	PIN	39-10184A10	103259	17

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION: A4A16, MIXER PC ASSEMBLY #1-82822K98

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
A4A16	ASSEMBLY, Mixer PC (Rev C)	1-82822K98	05547001	REF
C1	CAPACITOR, Chip .056 µF 20%, 100V	21-84309A23	100257	1
C2	CAPACITOR, Ceramic 2 pF	21-84309A40	117277	2
C3	Same as C2			
J1	RECEPTICAL, RF Jack	9-80321A46	103173	3
J2	Same as J1			
J3	Same as J1			
R1	RESISTOR, CC 68 Ω 5%, 1/8W	6-185A21	101700	1
R2	RESISTOR, CC 220 Ω 5%, 1/8W	6-185A33	101798	1
R3	RESISTOR, CC 470 Ω 5%, 1/8W	6-185A47	101709	1
R4	RESISTOR, CC 56 Ω 5%, 1/8W	6-185A19	101816	2
R5	RESISTOR, CC 75 Ω 5%, 1/8W	6-185A22	101818	1
R6	Same as R4			
U1	INTEGRATED CIRCUIT, ATF417 UH/VHF Amplifier	51-80321A92	103012	1
U2	INTEGRATED CIRCUIT, SAM-2 Mixer	51-82778K08	102815	1
	BOARD, PC		055470	1
	TERMINAL, Swage	29-84209D51	100482	1
	SHIELD, Mixer Synth	26-80321A80	055726	1
	SCREW, PHMS 2-56 x 3/16	3-80311A72	10062503	4
	WASHER, Split Lock #2	4-400139	100661	4
	WASHER, Flat #2	4-80311A76	100614	4

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A17, CONNECTOR PC ASSEMBLY #1-82778K29

REF. #	DESCRIPTION	MOTOROLA PART NO.	S–D PART NO.	QTY PER ASSY
A4A17	ASSEMBLY, Connector PC (Rev A)	1-82778K29	05569301	REF
	BRACKET	7-82778K68	05544401	2
	SPACER, Swage 4-40	29-80311A50	100492	2
	SPACER, Swage #6		103951	1
	NUT, Speed 4-40	2-82778K77	100656	2
	SCREW, PHMS 4-40 x 3/16	3-82778K78	10062603	2
	WASHER, Flat #4	4-7607	100703	2
	BOARD, PC		055693	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A4A18, L.O. SWITCH PC ASSEMBLY #1-80306A45

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
A4A18	ASSEMBLY, L.O. Switch PC (Rev C)	1-80306A45	05715301	REF
C1	CAPACITOR, Ceramic .001 µF 20%, 50V	21-82187B14	100251	3
C2	Same as C1			
C3	Not Used			
C4	Not Used			
C5	Same as C1			
C6	CAPACITOR, Chip .056 µF 20%, 100V	21-84309A23	100257	2
C7	Same as C6			
CR1	DIODE, Pin 5082-3188	48-80321A01	103338	3
CR2	DIODE, Pin 47688	48-84204D04	100447	2
CR3	Same as CR1			
CR4	Same as CR2			
CR5	Same as CR1			
R1	RESISTOR, CC 1.5 k 5%, 1/4W	6-124A53	101577	2
R2	RESISTOR, CC 1 k 5%, 1/4W	6-124A49	101569	3
R3	Same as R2			
R4	Same as R2			
R5	Same as R1			
	BOARD, PC		057153	1
	BOX, L.O. Switch	15-82778K79	057150	1
	SCREW, PHMS 2-56 x 3/16	3-80311A72	10062503	4
	WASHER, Split Lock #2	4-400139	100661	4
	WASHER, Flat #2	4-80311A76	100614	4
	TERMINAL, Swage	29-84209D51	100482	1
	PLUG, Snap-on SMB	28-84205D84	101247	1
	RECEPTICAL, SMA	9-80321A64	103409	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION: CLOCK OSCILLATOR ASSEMBLY #1-80307A27

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
	ASSEMBLY, Clock Oscillator (Rev E)	1-80307A27	05756001	REF
1	OSCILLATOR, Chassis	1-80307A27	057524	1
2	ASSEMBLY, Oscillator Control PC (A5)	1-80307A28	05754001	1
3	OSCILLATOR	1-80321A10	053743	1
4	BRACKET, Oscillator Mounting	7-80311A98	039813	1
5	CLAMP, Oscillator	42-80311A34	039048	2
6	CONNECTOR, BNC (J5 & J6)	9-82393K04	101155	2
7	SOCKET, Octal 8-pin	9-84205D76	102408	1
9	RIVET, 1/8 x 1/8	5-6819	100645	2
10	SCREW, PHMS 6-32 x 1/4	3-80311A26	10063204	5
11	WASHER, Flat #6	4-1720	100704	5
12	CAPACITOR, Ceramic .02 µF, 500V	21-401029	106489	2
13	CAPACITOR, Ceramic .01 µF +80-20%,100V	21-84309A25	100103	1
14	CAPACITOR, Ceramic 1 µF 20%, 50V	21-84208D96	100176	2
15	SCREW, PHMS 6-32 x 3/8	3-80311A24	10063206	4
16	LUG, BNC Solder	29-80329A75	107077	2
17	WASHER, Flat #6	4-1720	100704	4
18	NUT, Kep #6	2-7005	100706	4
19	CONNECTOR, Male 12-pin (P8)	15-80319A87	102808	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A5, OSCILLATOR CONTROL PC ASSEMBLY #1-80307A28

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
A5	ASSEMBLY, Oscillator Control (Rev D)	1-80307A28	05754001	REF
C1	CAPACITOR, Ceramic .01 µF +80-20%, 100V	21-84309A25	100103	6
C2	Same as C1			
C3	Same as C1			
C4	Same as C1			
C5	CAPACITOR, DM 100 pF 5%, 500V	21-84309A44	100173	1
C6	CAPACITOR, DM 220 pF 5%, 500V	21-82537B06	100220	1
C7	CAPACITOR, Tant 39 µF 10%, 10V	23-82783B36	100183	1
C8	CAPACITOR, Tant 15 µF 10%, 20V	23-82393K20	100211	2
C9	Same as C9			
C10	Same as C1			
C11	Same as C1			
C12	Not Used			
C13	Not Used			
C14	Not Used			
C15	CAPACITOR, DM 68 pF 500V	21-873266	100329	2
C16	Same as C15			
CR1	DIODE, Signal 1N4151	48-84309A57	100385	8
CR2	Same as CR1			
CR3	Same as CR1			
CR4	Same as CR1			
CR5	Same as CR1			
CR6	Same as CR1			
CR7	Same as CR1			
CR8	Same as CR1			
Q1	TRANSISTOR, NPN Silicon 2N4275 Sel.	48-80332A08	037592	2
Q2	Same as Q1			
Q3	TRANSISTOR, PNP Silicon PN3645	48-84307A21	101367	1
R1	RESISTOR, CC 1.5 k 5%, 1/4W	6-124A53	101577	2
R2	RESISTOR, CC 470 Ω 5%, 1/4W	6-124A41	101625	6
R3	RESISTOR, CC 4.7 k 5%, 1/4W	6-124A65	101598	2
R4	RESISTOR, CC 220 Ω 5%, 1/4W	6-124A33	101566	5
R5	Same as R1			
R6	Same as R2			
R7	Same as R3			
R8	Same as R4			
R9	RESISTOR, CC 3.3 k 5%, 1/4W	6-124A61	101559	1
R10	Same as R2			
R11	Same as R2			
R12	RESISTOR, CC 1 k 5%, 1/4W	6-124A49	101569	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A5, OSCILLATOR CONTROL ASSEMBLY #1-80307A28 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
R13	RESISTOR, CC 6.8 k 5%, 1/4W	6-124A69	101544	1
R14	Same as R2			
R15	RESISTOR, CC 150 Ω 5%, 1/4W	6-124A29	101615	1
R16	Same as R2			
R17	RESISTOR, CC 56 Ω 5%, 1/4W	6-124A19	101735	1
R18	Not Used			
R19	Same as R4			
R20	Same as R4			
R21	Same as R4			
R22	RESISTOR, CC 2.7 k 5%, 1/4W	6-124A59	101599	2
R23	Same as R22			
U1	INTEGRATED CIRCUIT, MC10102P ECL Quad 2-Input NOR Gate		103025	1
U2	INTEGRATED CIRCUIT, MC10137L ECL Sync Counter	51-80321A73	103027	1
U3	INTEGRATED CIRCUIT, SN74121N TTL SSI One Shot Multivibrator		025760	1
	BOARD, PC		057540	1
	TERMINAL, Swage	29-84209D51	100482	26
	TERMINAL,	29-84209D52	100508	2

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION: CLOCK OSCILLATOR ASSEMBLY OPTION 01 #1-80307A92

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
	ASSEMBLY, Clock Oscillator (Rev B)	1-80307A92	05756003	1
1	OSCILLATOR, Chassis	1-80307A27	057524	1
2	ASSEMBLY, Oscillator Control PC (A5)	1-80307A93	05754003	1
3	OSCILLATOR	1-80307A94	03342801	1
4	TRANSFORMER (T2)	25-80313A35	053959	1
5	INTEGRATED CIRCUIT, MC7824 Voltage Regulator +24V	51-83819K42	045246	1
6	CONNECTOR, BNC	9-82393K04	101155	2
7	SCREW, PHMS 4-40 x 1/4	3-80311A60	10062604	1
9	SCREW, PHMS 6-32 x 5/16	3-80311A23	10063205	6
10	SCREW, PHMS 6-32 x 1/4	3-80311A26	10063204	5
11	WASHER, Split Lock #6	4-7669	100712	8
12	WASHER, Split #4	4-114583	100711	1
13	WASHER, Flat #4	4-7607	100703	1
15	SCREW, PHMS 6-32 x 3/8	3-80311A24	10063206	2
16	LUG, BNC Solder	29-80329A75	107077	2
17	WASHER, Flat #6	4-1720	100704	7
19	CONNECTOR, Male 12-pin	15-80319A87	102808	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A5, OSCILLATOR CONTROL PC ASSEMBLY Option 01

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
A5	ASSEMBLY, Oscillator Control PC Option 01 (Rev C)	1-80307A93	05754003	1
C1	CAPACITOR, Disc .01 µF +80-20%, 100V	21-84309A25	100103	6
C2	Same as C1			
C3	Not Used			
C4	Same as C1			
C5	CAPACITOR, CM 100 pF 5%, 500V	21-84309A44	100173	1
C6	CAPACITOR, CM 220 pF 5%, 500V	21-84309A33	100220	1
C7	CAPACITOR, Tant 39 µF 10%, 10V	23-82783B36	100183	1
C8	Not Used			
C9	Not Used			
C10	Same as C1			
C11	Same as C1			
C12	CAPACITOR, Tant 250 µF, 50V	23-80330A88	100365	2
C13	Same as C12			
C14	CAPACITOR, Tant 4.7 µF, 35V	23-82783B11	100071	1
C15	CAPACITOR, DM 68 pF, 500V	21-873266	100329	2
C16	Same as C15			
C17	CAPACITOR, DM 820 pF, 300V	21-873269	100174	1
C18	Same as C1			
CR1	DIODE, Signal 1N4151	48-84309A57	100385	9
CR2	Same as CR1			
CR3	Same as CR1			
CR4	Same as CR1			
CR5	Same as CR1			
CR6	Same as CR1			
CR7	Same as CR1			
CR8	Same as CR1			
CR9	Not Used			
CR10	Same as CR1			
CR11	Not Used			
CR12	Not Used			
CR13	DIODE, Rectifier 600V	48-82466H18	100413	4
CR14	Same as CR13			
CR15	Same as CR13			
CR16	Same as CR13			
L1	INDUCTOR, Fixed 3.3 µH	24-84206D16	03966601	1
Q1	TRANSISTOR, NPN Silicon 2N4275 Sel	48-80332A08	037592	2
Q2	Same as Q1			
Q3	TRANSISTOR, PNP Silicon PN3645	48-84307A21	101367	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A5, OSCILLATOR CONTROL Option 01 (Cont'd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
R1	RESISTOR, CC 1.5 k 5%, 1/4W	6-124A53	101577	1
R2	RESISTOR, CC 470 Ω 5%, 1/4W	6-124A41	101625	7
R3	RESISTOR, CC 4.7 k 5%, 1/4W	6-124A65	101598	2
R4	RESISTOR, CC 220 Ω 5%, 1/4W	6-124A33	101566	5
R5	Not Used			
R6	Same as R2			
R7	Same as R3			
R8	Same as R4			
R9	RESISTOR, CC 3.3 k 5%, 1/4W	6-124A61	101559	1
R10	Same as R2			
R11	Same as R2			
R12	RESISTOR, CC 1 k 5%, 1/4W	6-124A49	101569	1
R13	RESISTOR, CC 6.8 k 5%, 1/4W	6-124A69	101544	1
R14	Same as R2			
R15	RESISTOR, CC 150 Ω 5%, 1/4W	6-124A29	101615	1
R16	Same as R2			
R17	RESISTOR, CC 56 Ω 5%, 1/4W	6-124A19	101735	1
R18	Same as R2			
R19	Same as R4			
R20	Same as R4			
R21	Same as R4			
R22	RESISTOR, CC 2.7 k 5%, 1/4W	6-124A59	101599	2
R23	Same as R22			
S1	SWITCH, AC Line	40-80330A84	103301	1
U1	INTEGRATED CIRCUIT, MC10102P ECL Quad 2-Input NOR Gate	51-80330A77	103025	1
U2	INTEGRATED CIRCUIT, MC10137L ECL Sync Counter	51-80321A73	103027	1
U3	INTEGRATED CIRCUIT, SN74121N TTL SSI One Shot Multivibrator	51-6473A01	025760	1
	BOARD, PC		057540	1
	TERMINAL	29-84209D51	100482	26
	TERMINAL	29-84209D52	100508	2

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION CLOCK OSCILLATOR ASSEMBLY OPTION 02 #1-80307A95

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
	ASSEMBLY, Clock Oscillator (Rev B)	1-80307A95	05756002	1
1	OSCILLATOR, Chassis	1-80307A27	057524	1
2	ASSEMBLY, Oscillator Control (A5)	1-80307A96	05754002	1
6	CONNECTOR, BNC (J5 & J6)	9-82393K04	101155	2
10	SCREW, PHMS 6-32 x 1/4	3-80311A26	10063204	5
11	WASHER, Flat #6	4-1720	100704	5
15	SCREW, PHMS 6-32 x 3/8	3-80311A24	10063206	4
16	LUG, BNC Solder	29-80329A75	107077	2
19	CONNECTOR, Male 12-pin	15-80319A87	102808	1

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A5, OSCILLATOR CONTROL PC ASSEMBLY Option 02

REF. #	DESCRIPTION	MOTOROLA PART NO.	S–D PART NO.	QTY PER ASSY
A5	ASSEMBLY, Oscillator Control PC Option 02 (Rev C)		05754002	1
C1	CAPACITOR, Disc .01 µF +80-20%, 100V	21-84309A25	100103	6
C2	Same as C1			
C3	Same as C1			
C4	Same as C1			
C5	CAPACITOR, DM 100 pF 5%, 500V	21-84309A44	100173	1
C6	CAPACITOR, CM 220 pF 5%, 500V	21-84309A33	100220	1
C7	CAPACITOR, Tant 39 µF 10%, 10V	23-82783B36	100183	1
C8	CAPACITOR, Tant 15 µF 10%, 20V	23-82393K20	100211	1
C9	Not Used			
C10	Same as C1			
C11	Same as C1			
C12	Not Used			
C13	Not Used			
C14	Not Used			
C15	CAPACITOR, CM 68 pF, 500V		100329	2
C16	Same as C15			
CR1	DIODE, Signal 1N4151	48-84309A57	100385	10
CR2	Same as CR1			
CR3	Same as CR1			
CR4	Same as CR1			
CR5	Same as CR1			
CR6	Same as CR1			
CR7	Same as CR1			
CR8	Same as CR1			
CR9	Same as CR1			
CR10	Same as CR1			
Q1	TRANSISTOR, NPN Silicon 2N4275 Sel	48-80332A08	037592	2
Q2	Same as Q1			
Q3	TRANSISTOR, PNP Silicon PN3645	48-84307A21	101367	1
R1	RESISTOR, CC 1.5 k 5%, 1/4W	6-124A53	101577	2
R2	RESISTOR, CC 470 Ω 5%, 1/4W	6-124A41	101625	6
R3	RESISTOR, CC 4.7 k 5%, 1/4W	6-124A65	101598	2
R4	RESISTOR, CC 220 Ω 5%, 1/4W	6-124A33	101566	5
R5	Same as R1			
R6	Same as R2			
R7	Same as R3			
R8	Same as R4			
R9	RESISTOR, CC 3.3 k 5%, 1/4W	6-124A61	101559	1
R10	Same as R2			

REPLACEABLE PARTS LIST

EQUIPMENT/ASSEMBLY DESIGNATION A5, OSCILLATOR CONTROL PC ASSEMBLY Option 02 (Contd)

REF. #	DESCRIPTION	MOTOROLA PART NO.	S-D PART NO.	QTY PER ASSY
R11	Same as R2			
R12	RESISTOR, CC 1 k 5%, 1/4W	6-124A49	101569	1
R13	RESISTOR, CC 6.8 k 5%, 1/4W	6-124A69	101544	1
R14	Same as R2			
R15	RESISTOR, CC 150 Ω 5%, 1/4W	6-124A29	101615	1
R16	Same as R2			
R17	RESISTOR, CC 56 Ω 5%, 1/4W	6-124A19	101735	1
R18	Not Used			
R19	Same as R4			
R20	Same as R4			
R21	Same as R4			
R22	RESISTOR, CC 2.7 k 5%, 1/4W	6-124A59	101599	2
R23	Same as R22			
U1	INTEGRATED CIRCUIT, MC10102P ECL Quqd 2-Input NOR Gate	51-80330A77	103025	1
U2	INTEGRATED CIRCUIT, MC10137L ECL Sync Counter	51-80321A73	103027	1
U3	INTEGRATED CIRCUIT, SN74121N TTL SSI One Shot Multivibrator	51-6473A01	025760	1
U4	ASSEMBLY, Crystal Oscillator 4 MHz	1-83819K46	055284	1
	BOARD, PC		057540	1
	TERMINAL	29-84209D51	100482	26
	TERMINAL	29-84209D52	100508	2

CHAPTER 7
DRAWINGS

7.1 INTRODUCTION

This chapter contains the schematic and component location diagrams of the Model R-1201A Signal Generator. The schematic diagrams relate to the detailed circuit descriptions located in Chapter 4 of this manual. The parts list contained in Chapter 6, relate to the reference designation callouts on the schematic and component location diagrams. Table 7-1 provides a list by figure number of the drawing, with title, drawing number andmanual page number.

TABLE 7-1 LIST OF SCHEMATIC AND COMPONENT LOCATIONS DIAGRAMS

FIG. NO.	TITLE	DRAWING NUMBER	PAGE NO.
7-1	Model R-1201A Test Assembly (Sheet 1 of 3)	057586	7-3
7-2	Model R-1201A Test Assembly (Sheet 2 of 3)	057586	7-4
7-3	Model R-1201A Test Assembly (Sheet 3 of 3)	057586	7-5
7-4	Model R-1201A Bottom Cover	067310	7-6
7-5	Model R-1201A Front Panel	057585	7-6
7-6	Power Supply Chassis	057559	7-7
7-7	Power Regulator Plug-In	057646	7-8
7-8	Rectifier PC Assembly	05760601	7-8
7-9	Power Supply Schematic	057684	7-9
7-10	A3, Motherboard	05790001	7-10
7-11	A3, Motherboard Schematic	05790001	7-11
7-12	A3A1, Frequency Switch PCB Assembly	05754101	7-12
7-13	A3A1, Frequency Switch Schematic	05754101	7-13
7-14	A3A2, Display PCB Assembly	05754401	7-14
7-15	A3A2, Display Schematic	05754401	7-15
7-16	A3A3, Modulation Control PCB Assembly	05788201	7-16
7-17	A3A3, Modulation Control Schematic	05788201	7-17
7-18	A4A15, Motherboard/Cable Assembly	057228	7-18
7-18	A4A15, Motherboard PCB Assembly	05569201	7-18
7-19	A4A15, Motherboard Schematic	05569201	7-19
7-20	A4A1, AC Discriminator PCB Assembly	05563901	7-20
7-21	A4A1, AC Discriminator Schematic	05563901	7-21
7-22	A4A2, 10 MHz VCO PBC Assembly	05566201	7-22
7-23	A4A2, 10 MHz VCO Schematic	05566201	7-23
7-24	A4A3, DC Discriminator PCB Assembly	05537401	7-24
7-25	A4A3, DC Discriminator Schematic	05537401	7-25
7-26	A4A4, Time Base Divider PCB Assembly	05395401	7-26
7-27	A4A4, Time Base Divider Schematic	05395401	7-27
7-28	A4A5, Source 2 PCB Assembly	05362401	7-28
7-29	A4A5, Source 2 Schematic	05362401	7-29
7-30	A4A6, Source 3 PCB Assembly	05373501	7-30
7-31	A4A6, Source 3 Schematic	05373501	7-31
7-32	A4A8, 400 MHz Reference Generator PCB Assembly	05566801	7-32
7-33	A4A8, 400 MHz Reference Generator Schematic	05566801	7-33
7-34	A4A9, Control Logic PCB Assembly	05567101	7-34
7-35	A4A9, Control Logic Schematic	05567101	7-35

TABLE 7-1 LIST OF SCHEMATIC AND COMPONENT LOCATION DIAGRAMS (Cont'd)

FIG. NO.	TITLE	DRAWING NUMBER	PAGE NO.
7-36	A4A10, Divide-By-N PCB Assembly	05567001	7-36
7-37	A4A10, Divide-By-N Schematic	05567001	7-37
7-38	A4A11, Source 4 PCB Assembly	05372401	7-38
7-39	A4A11, Source 4 Schematic	05372401	7-39
7-40	A4A12, Phase Detector PCB Assembly	05538501	7-40
7-41	A4A12, Phase Detector Schematic	05538501	7-41
7-42	A4A13, Source 5 PCB Assembly	05797001	7-42
7-43	A4A13, Source 5 Schematic	05797001	7-43
7-44	A4A14, Amplifier PCB Assembly	05392901	7-44
7-45	A4A14, Amplifier Schematic	05392901	7-45
7-46	A4A16, Mixer Assembly	05547001	7-46
7-47	A4A16, Mixer Schematic	05547001	7-47
7-48	A4A17, Connector Board	05569301	7-48
7-49	A4A18, L.O. Switch PCB Assembly	05715301	7-48
7-50	A4A18, L.O. Switch Schematic	05715301	7-49
7-51	A5, Std. Clock Oscillator Assembly	05756001	7-50
7-52	A5A1, Std. Oscillator Control PCB Assembly	05754001	7-50
7-53	A5A1, Std. Oscillator Control Schematic	05754001	7-51
7-54	A5, Opt. 01 High Stability Clock Osc. Chassis Assembly	05756003	7-52
7-55	A5A1, Opt. 01 High Stability Osc. Control PCB Assembly	05754003	7-52
7-56	A5A1, Opt. 01 High Stability Osc. Control Schematic	05754003	7-53
7-57	A5, Opt. 02 TCXO Clock Oscillator Assembly	05756002	7-54
7-58	A5A1, Opt. 02 TCXO Oscillator Control PCB Assembly	05754002	7-54
7-59	A5A1, Opt. 02 TCXO Oscillatoc Control Schematic	05754002	7-55

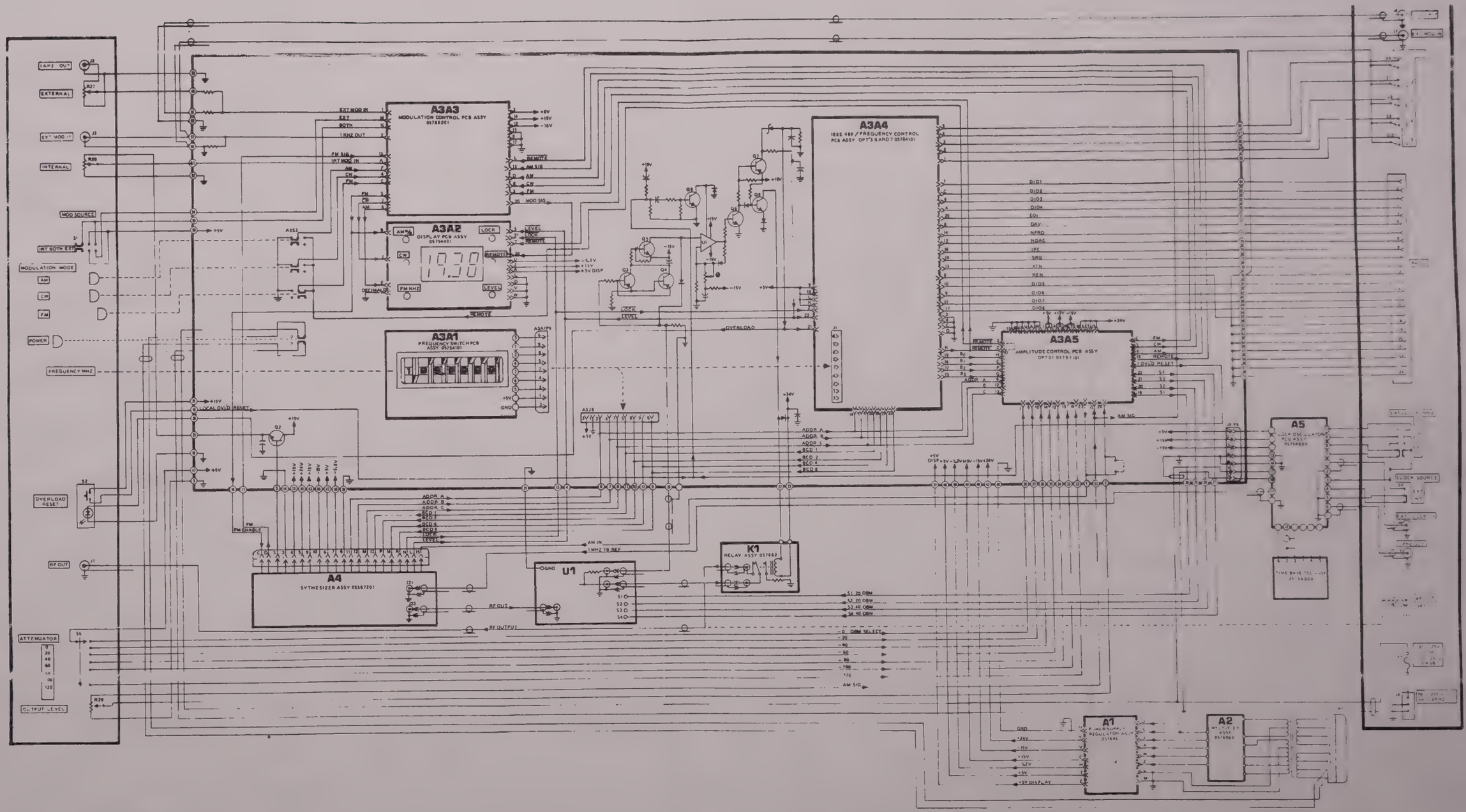


FIGURE 7-1
MODEL R-1201A TEST ASSEMBLY
(Sheet 1 of 3) #05759[illegible] REV E

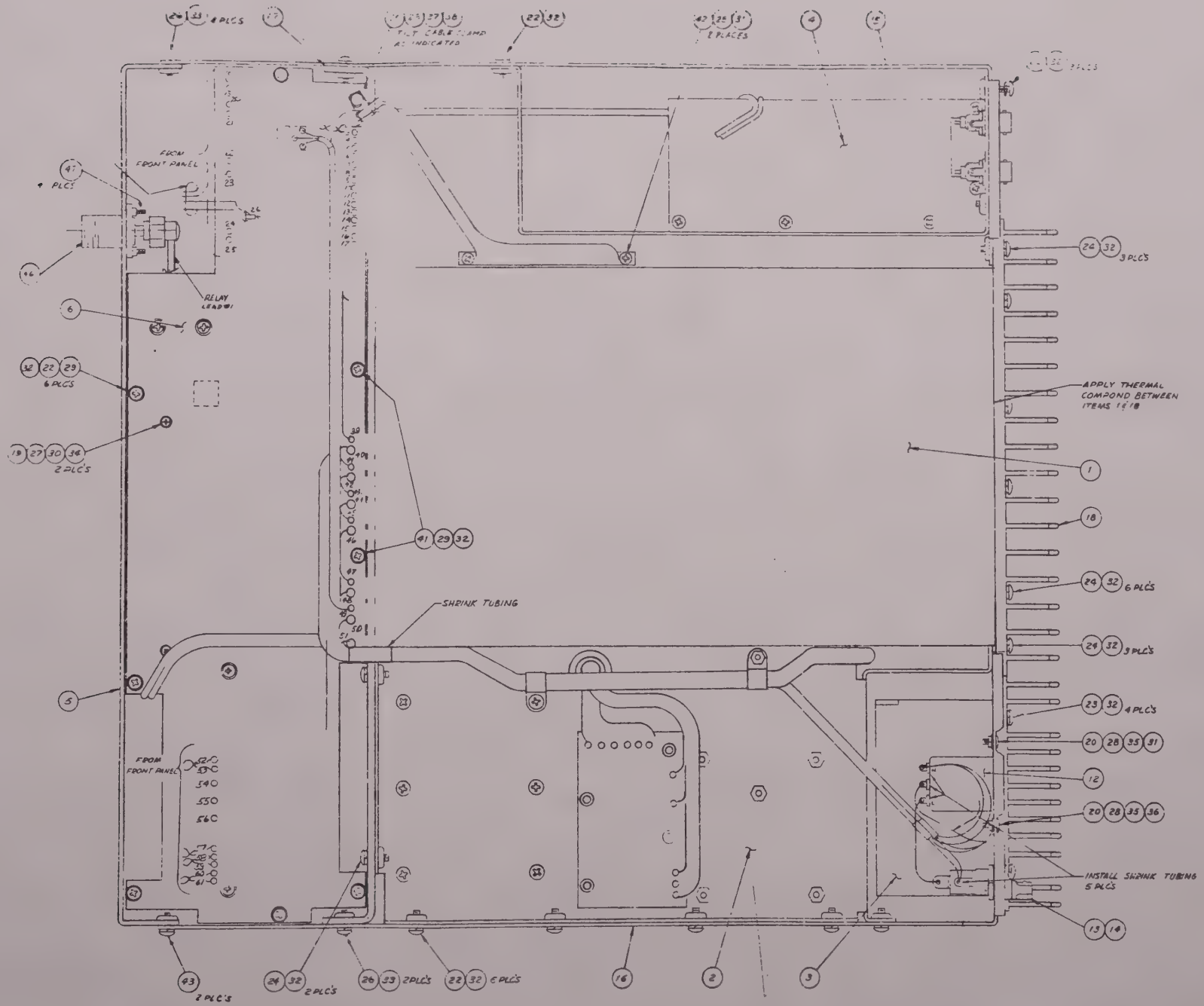


FIGURE 7-2
MODEL R-1201A TEST ASSEMBLY
(Sheet 2 of 3) #057586 Rev E

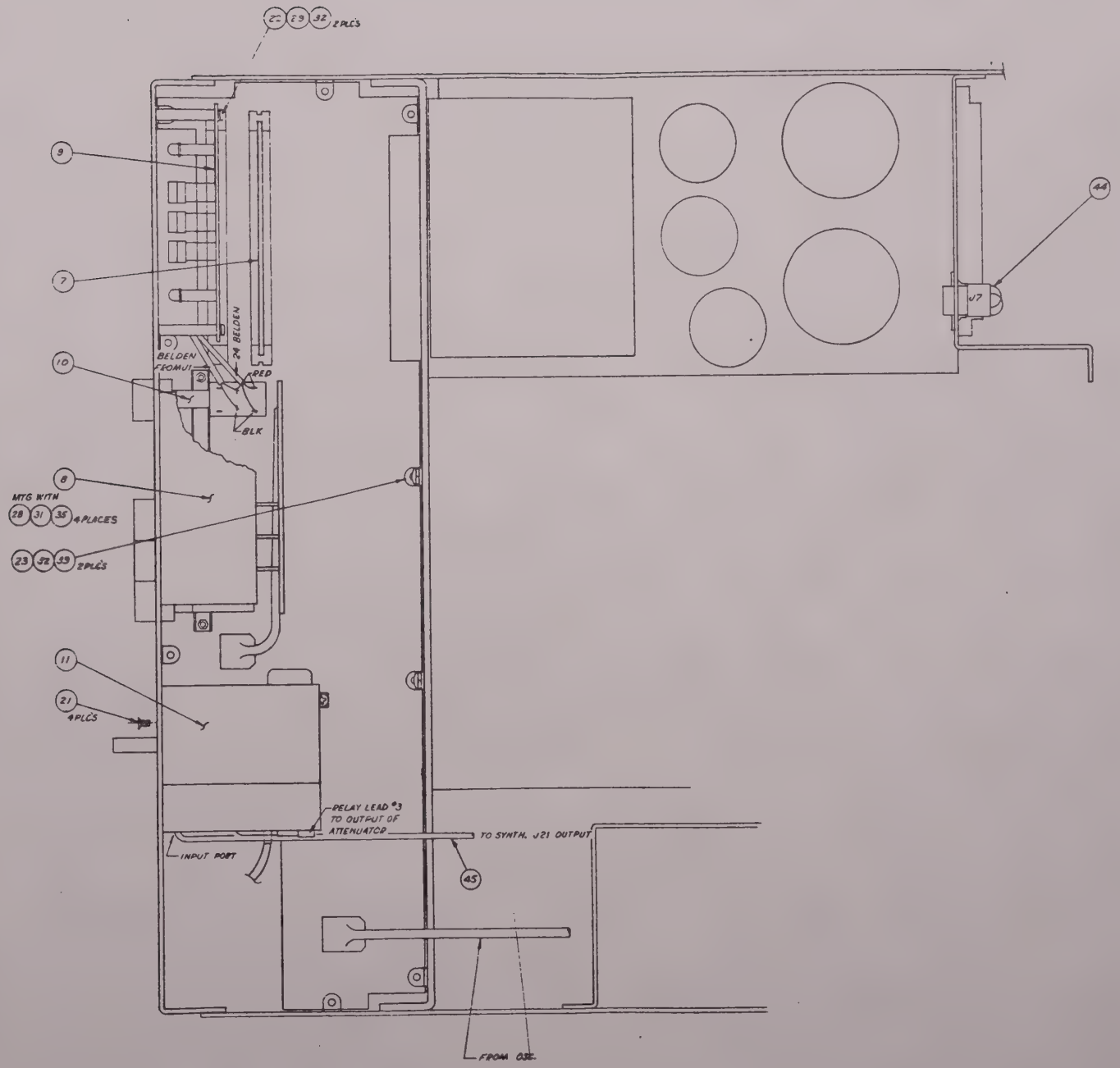


FIGURE 7-3
MODEL R-1201A TEST ASSEMBLY
(Sheet 3 of 3) #057586 Rev E

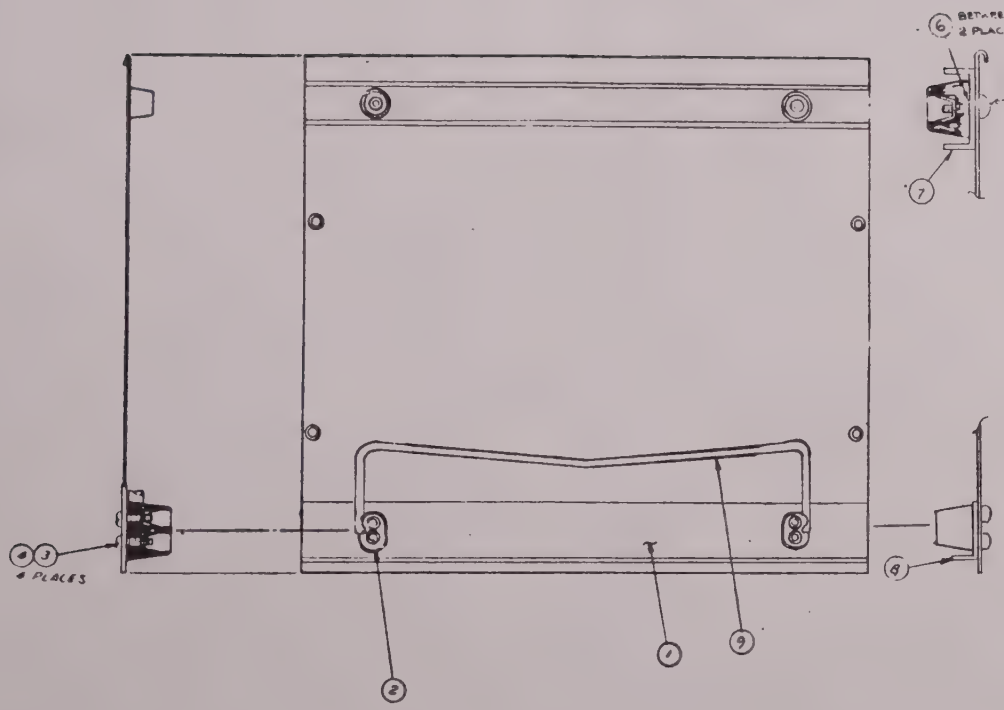

BETWEEN COVER & ROUND FOOT
2 PLACES
2 PLACES
SCREW MUST BE TIGHTENED WITH SCREWDRIVER TO INSURE TEETH OF INTERNAL TOOTH WASHER SEAT INTO COVER VINYL & PLASTIC FOOT DEEPLY.
4 PLACES

FIGURE 7-4
BOTTOM COVER
ASSEMBLY DRAWING #067310 Rev A

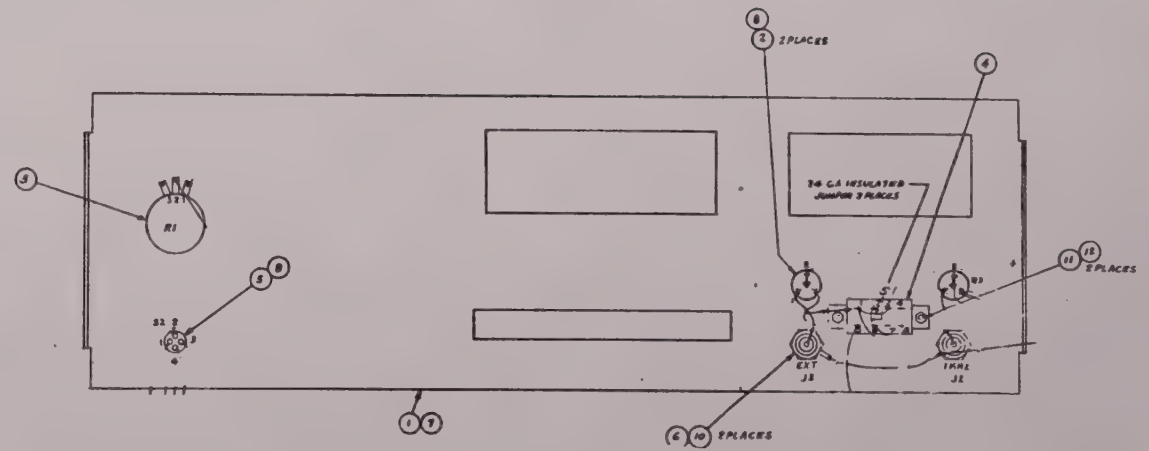


FIGURE 7-5
FRONT PANEL
ASSEMBLY DRAWING #057585 Rev E

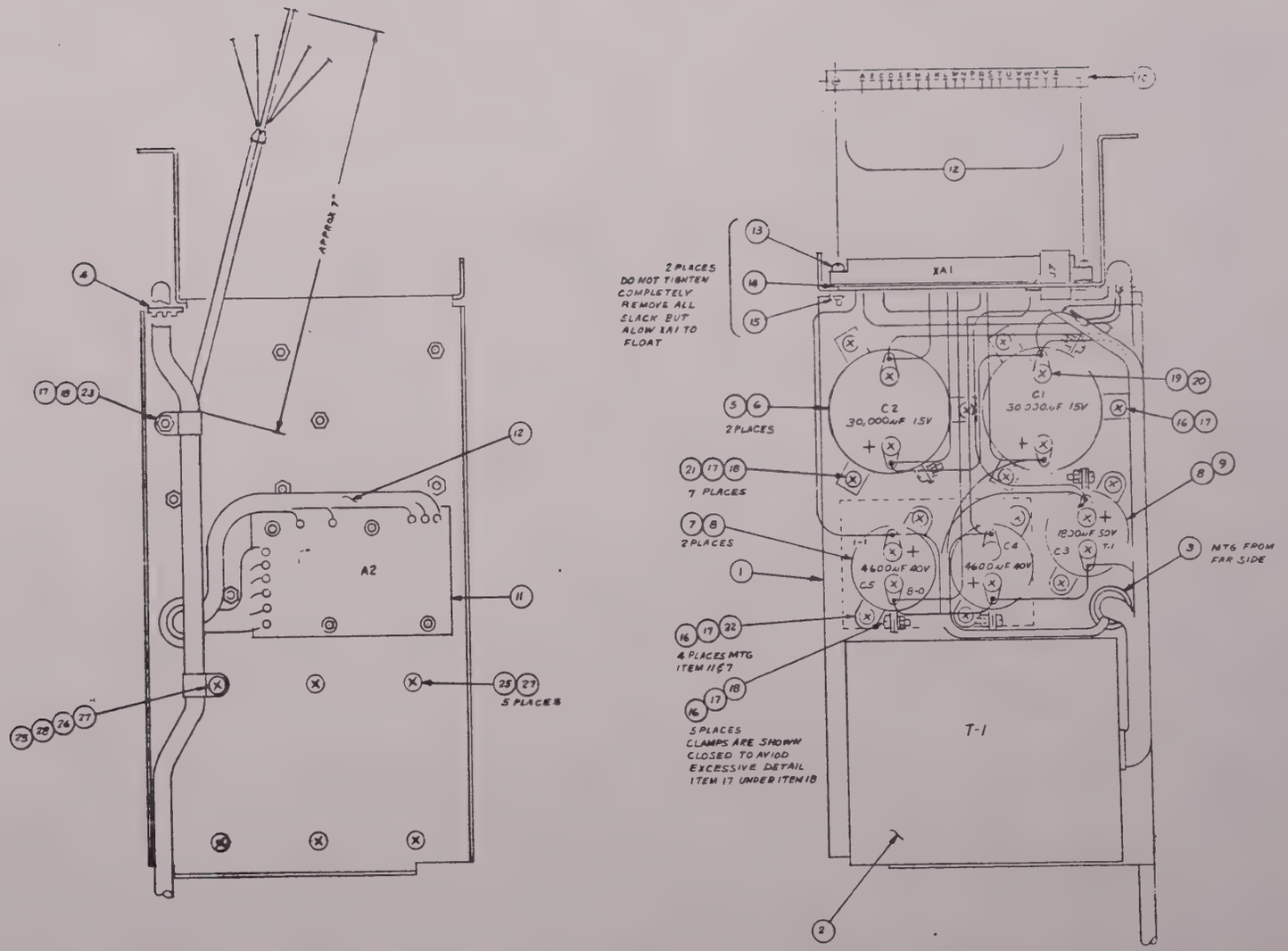


FIGURE 7-6
POWER SUPPLY CHASSIS
ASSEMBLY DRAWING #057559 Rev C

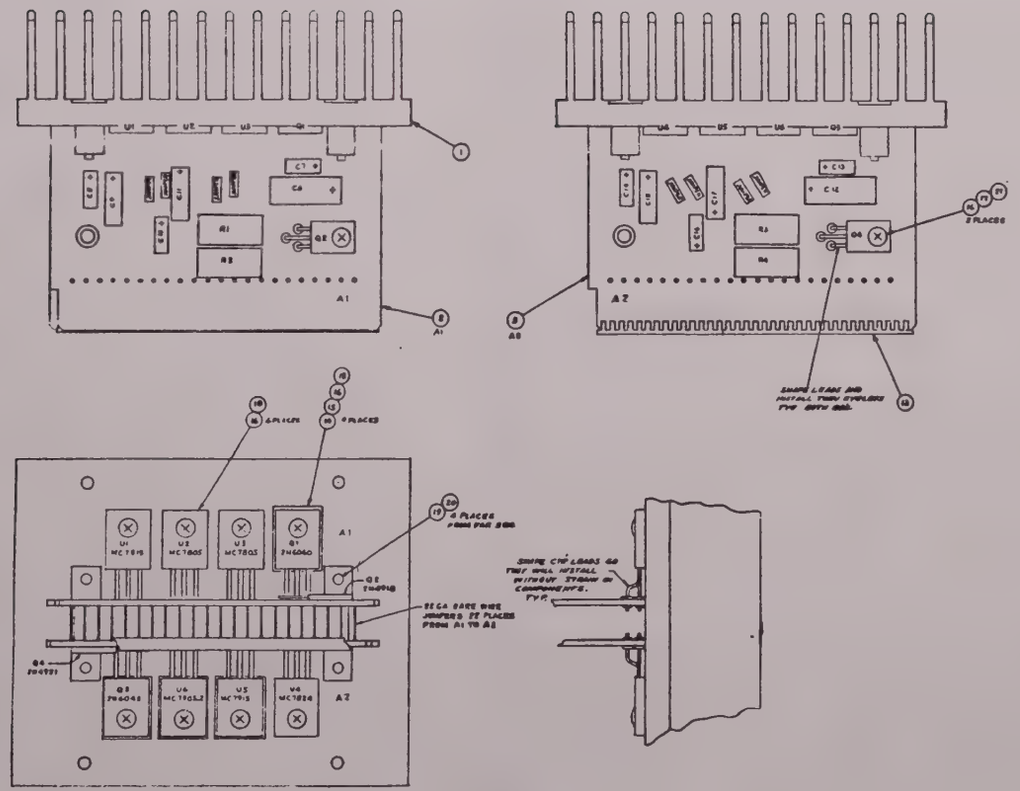


FIGURE 7-7
POWER REGULATOR PLUG-IN
ASSEMBLY DRAWING #057646 Rev C

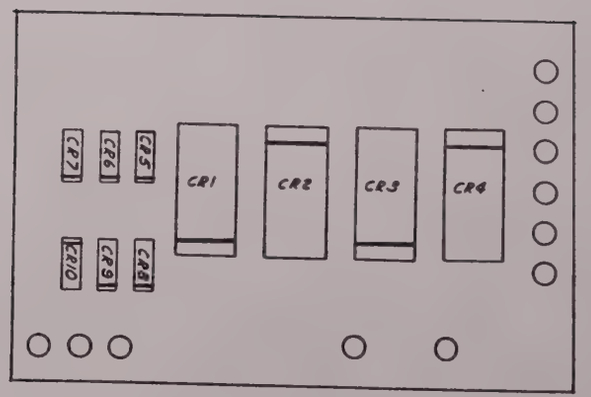


FIGURE 7-8
RECTIFIER PC ASSEMBLY
#05760601 Rev B

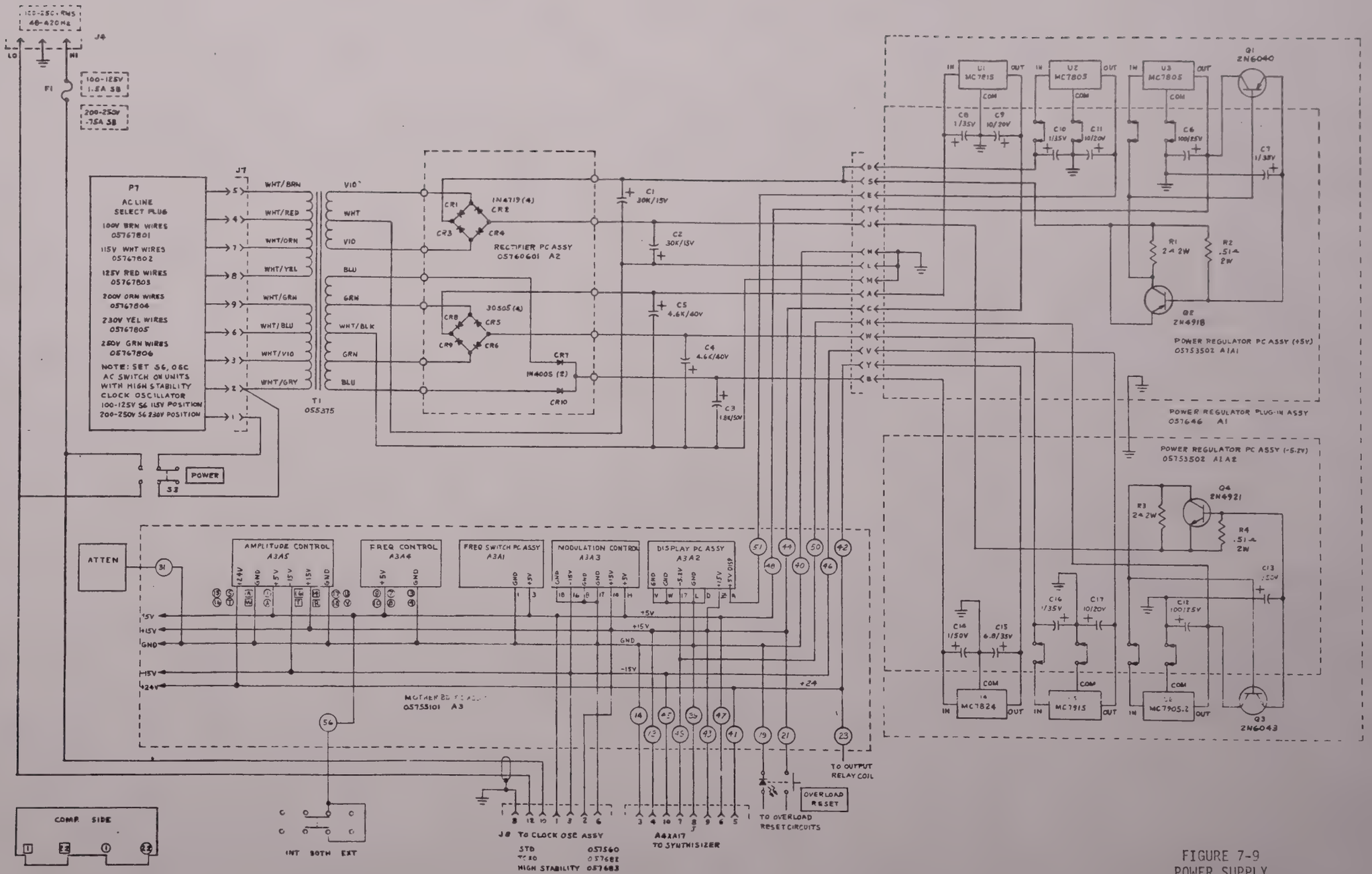


FIGURE 7-9
POWER SUPPLY
SCHEMATIC DIAGRAM #057684 Rev B

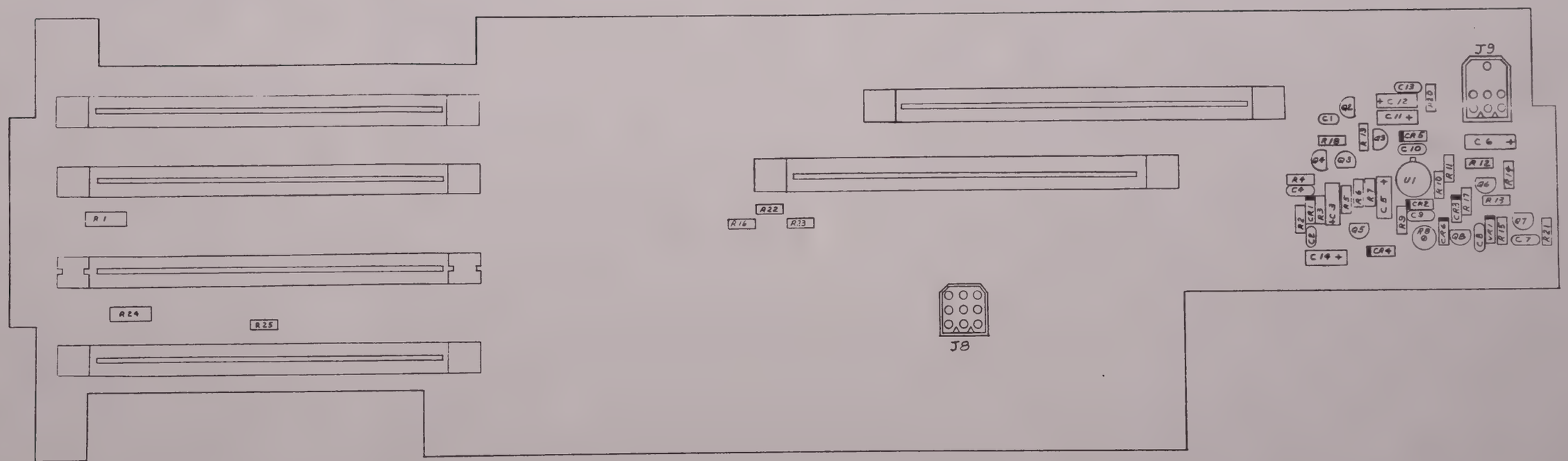


FIGURE 7-10
MOTHER BOARD (A3)
ASSEMBLY DRAWING #05790001 Rev B

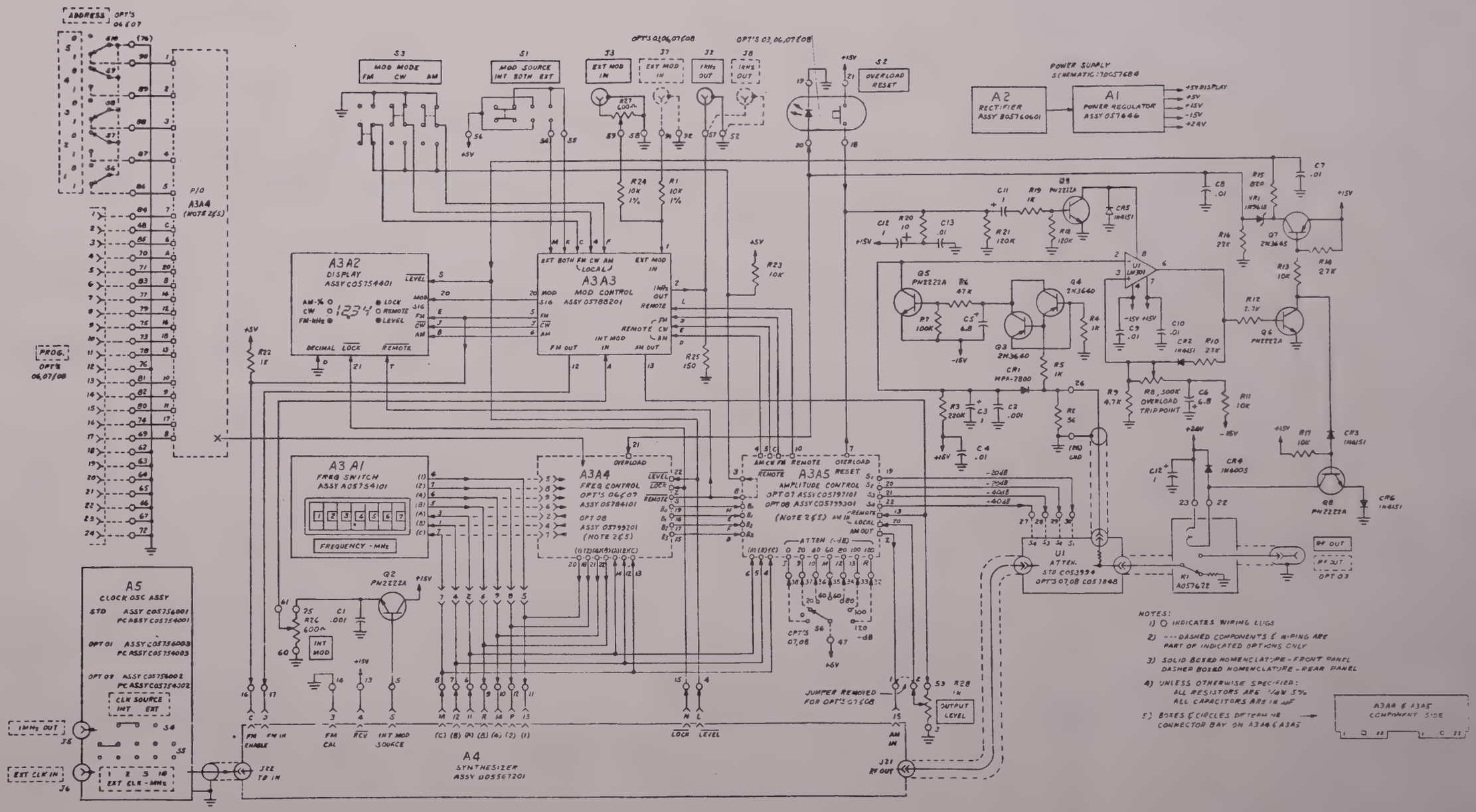

ADDRESS
OPT'S 06 & 07
P/O A3A4 (NOTE 2&5)
PROG. OPT'S 06,07 & 08
S3 MOD MODE FM CW AM
S1 MOD SOURCE INT BOTH EXT
J3 EXT MOD IN
J7 EXT MOD IN
J2 1MHz OUT
J8 1MHz OUT
OPT'S 02,06,07 & 08
OPT'S 03,06,07 & 08
S2 OVERLOAD RESET
POWER SUPPLY SCHEMATIC: 70657684
A2 RECTIFIER ASSY 80576060 1
A1 POWER REGULATOR ASSY 057646
+5V DISPLAY
+5V
+15V
-15V
+24V
A3A2 DISPLAY ASSY C0575440 1
A3A3 MOD CONTROL ASSY 05788201
A3A1 FREQ SWITCH ASSY A0575410 1
FREQUENCY - MHz
A3A4 FREQ CONTROL OPT'S 06 & 07 ASSY 05784101
OPT 08 ASSY 05799201 (NOTE 2&5)
A3A5 AMPLITUDE CONTROL OPT 07 ASSY C0579710 1
OPT 08 ASSY C0579930 1 (NOTE 2&5)
A5 CLOCK OSC ASSY
STD ASSY C0575600 1
PC ASSY C0575400 1
OPT 01 ASSY C0575600 3
PC ASSY C0575400 3
OPT 02 ASSY C0575600 2
PC ASSY C0575400 2
CLK SOURCE INT EXT
EXT CLK - MHz
1MHz OUT J5
EXT CLK IN J6
A4 SYNTHESIZER ASSY D0556720 1
J22 TO IN
J21 RF OUT
JUMPER REMOVED FOR OPT'S 07 & 08
OUTPUT LEVEL
U1 ATTEN. STD C0539940 OPT'S 07,08 C0578480
K1 A0576220
RF OUT
RF OUT OPT 03
NOTES:
1) ○ INDICATES WIRING LUGS
2) --- DASHED COMPONENTS & WIRING ARE PART OF INDICATED OPTIONS ONLY
3) SOLID BOXED NOMENCLATURE - FRONT PANEL DASHED BOXED NOMENCLATURE - REAR PANEL
4) UNLESS OTHERWISE SPECIFIED: ALL RESISTORS ARE 1/4W 5% ALL CAPACITORS ARE IN μF
5) BOXES & CIRCLES OF ITEM 4B CONNECTOR BAY ON A3A4 & A3A5
A3A4 & A3A5 COMPONENT SIDE

FIGURE 7-11
MOTHER BOARD (A3)
SCHEMATIC DIAGRAM #7-05790001 Rev B

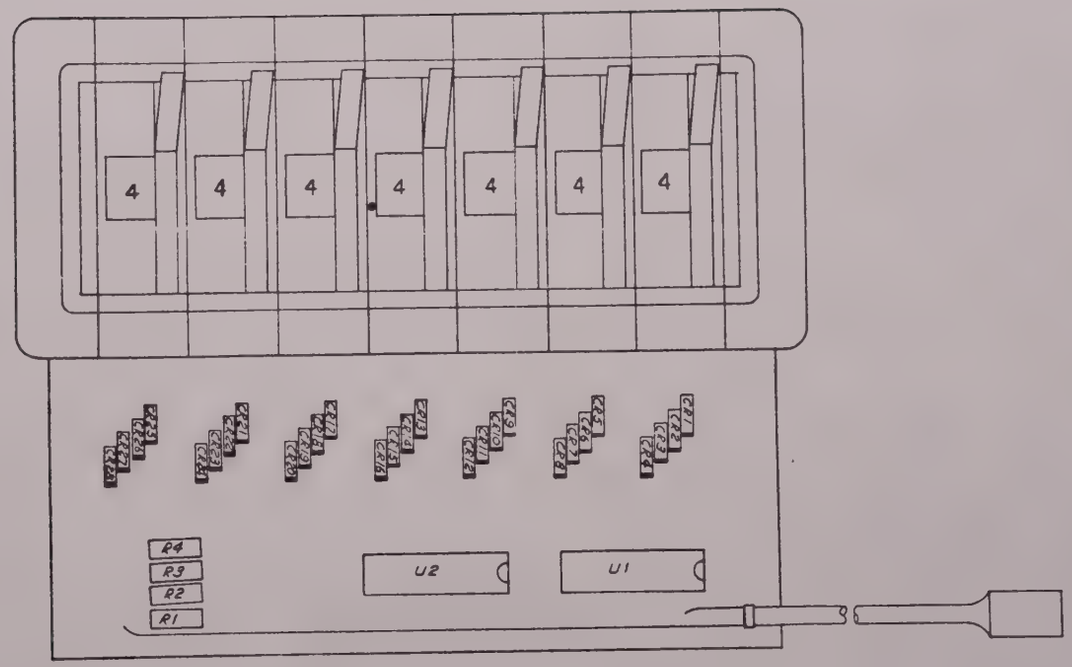
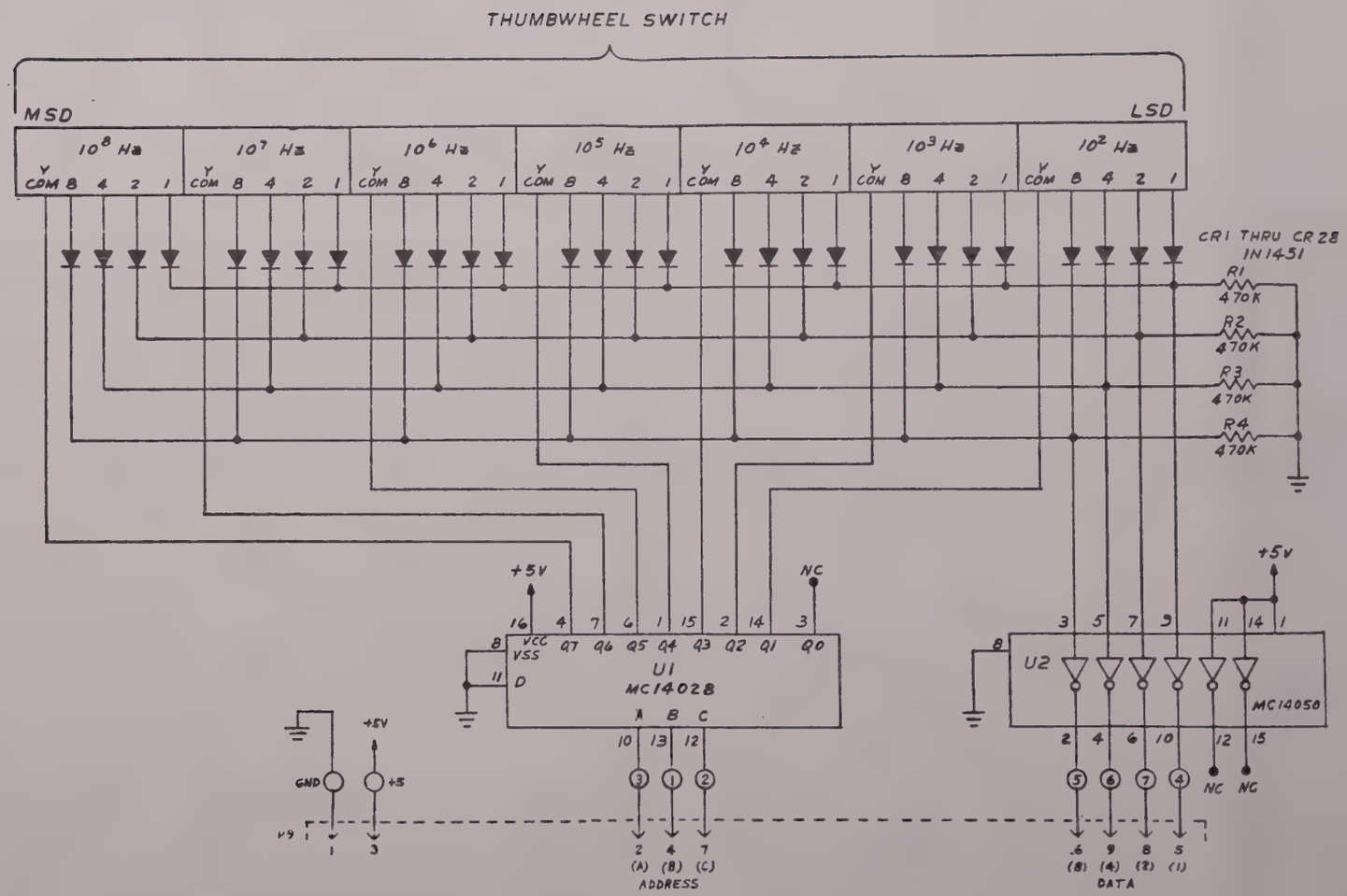


FIGURE 7-12
FREQUENCY SWITCH PCB (A3A1)
ASSEMBLY DRAWING #05754101 Rev B



NOTE

1. ALL RESISTORS ARE 1/4W CC.

FIGURE 7-13
FREQUENCY SWITCH PCB (A3A1)
SCHEMATIC DIAGRAM #05754101 Rev A

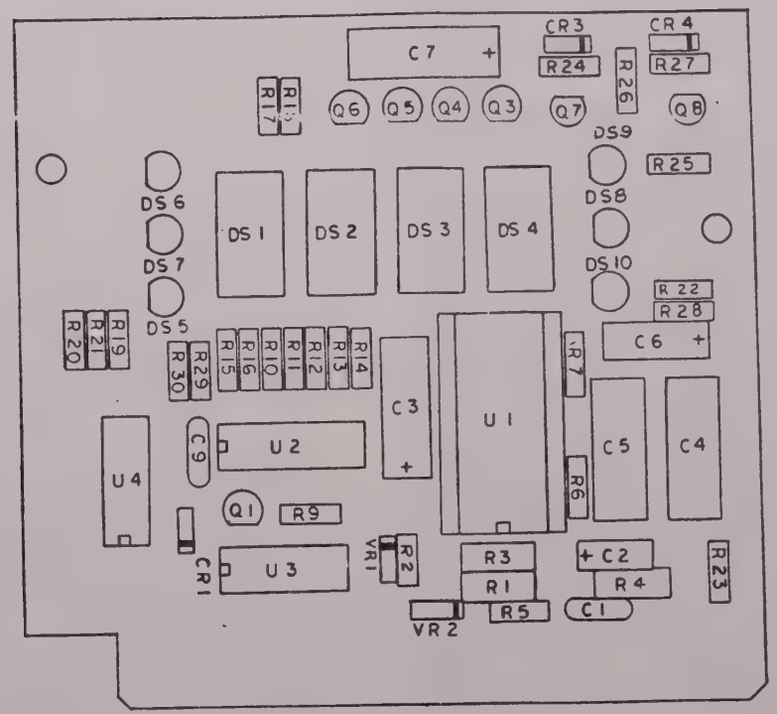
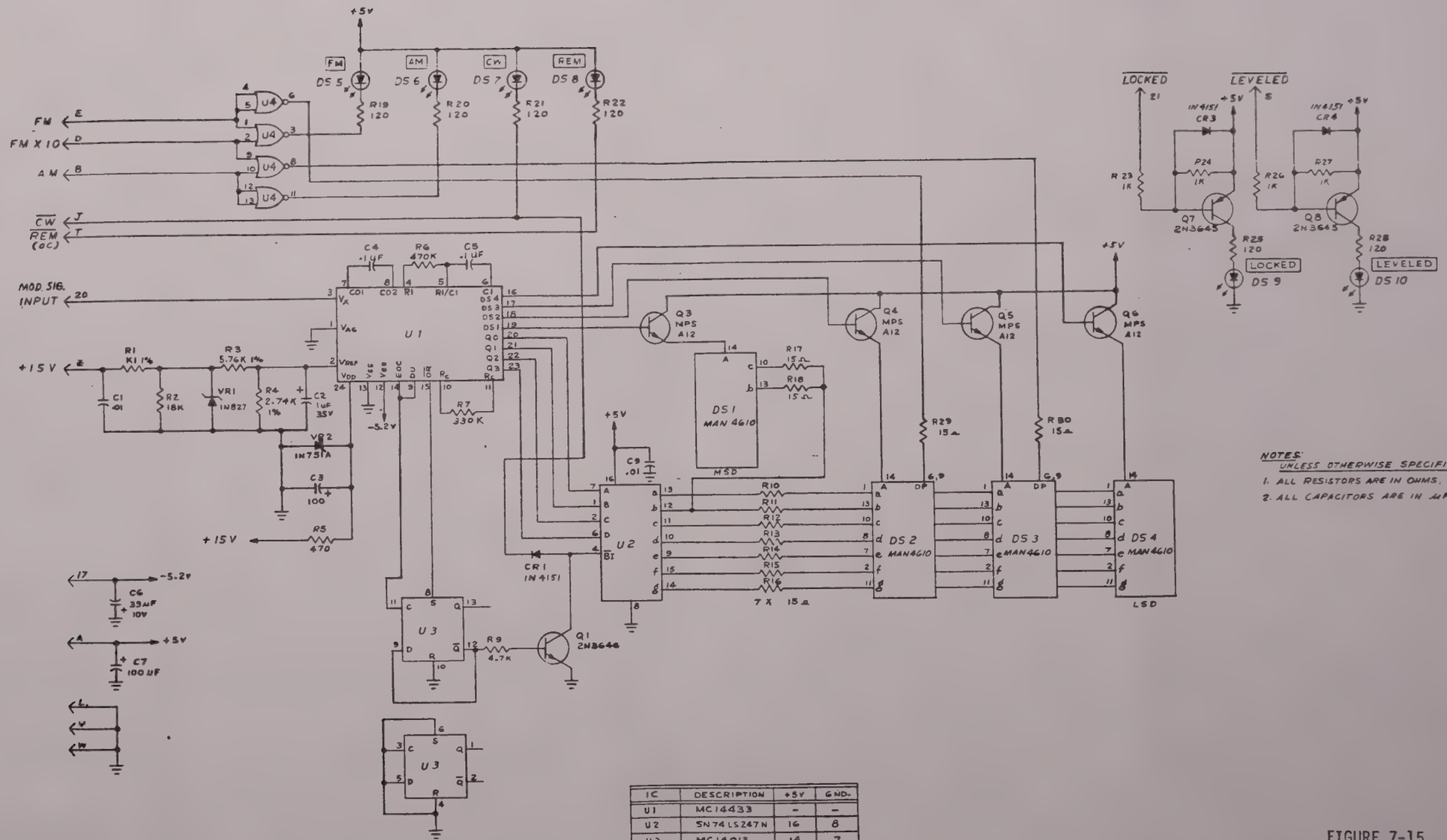


FIGURE 7-14
DISPLAY PCB (A3A2)
ASSEMBLY DRAWING #05754401 Rev E



NOTES:
UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, ¼W, 5%
2. ALL CAPACITORS ARE IN μF.

IC	DESCRIPTION	+5V	GND
U1	MC14433	-	-
U2	SN74LS247N	16	8
U3	MC14013	14	7
U4	MC3002P	14	7

FIGURE 7-15
DISPLAY 3 1/2 DIGIT PCB (A3A2)
SCHEMATIC DIAGRAM #05754401 Rev C

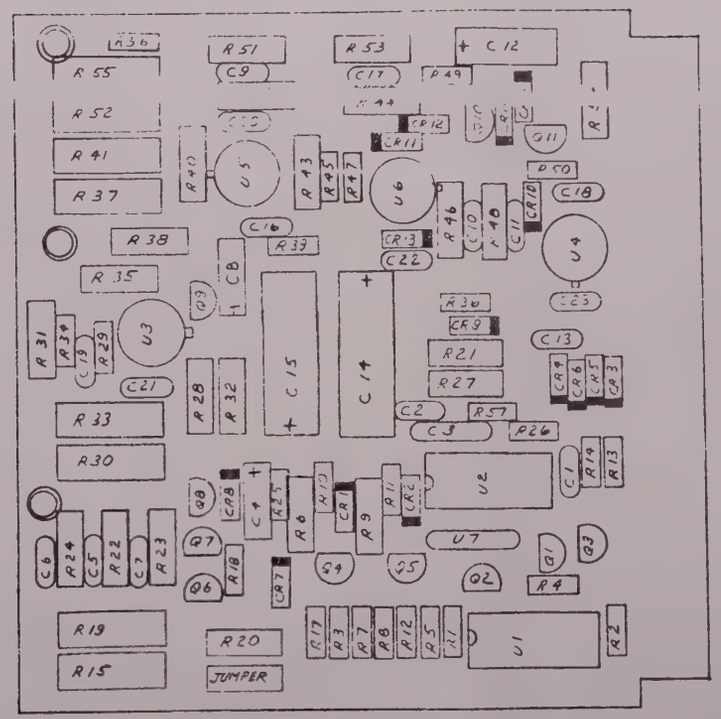


FIGURE 7-16
MODULATION CONTROL PCB (A3A3)
ASSEMBLY DRAWING #05788201 Rev D

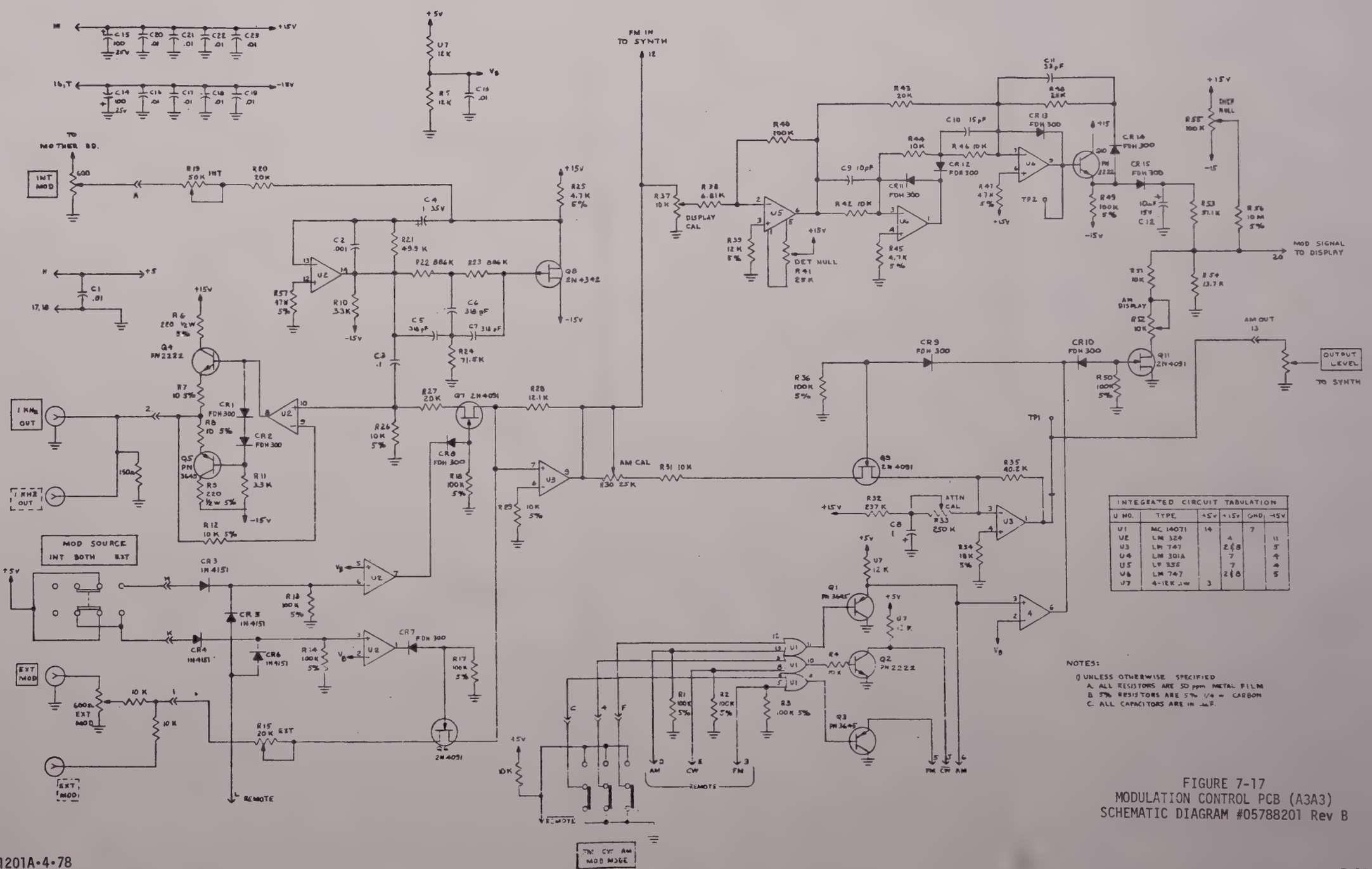

INTEGRATED CIRCUIT TABULATION
U NO. | TYPE | +5V | +15V | GND | -15V
U1 | MC 14071 | 14 | | 7 |
U2 | LM 324 | | 4 | | 11
U3 | LM 747 | | 2&8 | | 5
U4 | LM 301A | | 7 | | 4
U5 | LF 355 | | 7 | | 4
U6 | LM 747 | | 2&8 | | 5
U7 | 4-12K 1% | 3 | | |
NOTES:
() UNLESS OTHERWISE SPECIFIED
A. ALL RESISTORS ARE 50 ppm METAL FILM
B. 5% RESISTORS ARE 5% 1/4 w CARBON
C. ALL CAPACITORS ARE IN µF.
MOD SOURCE
INT BOTH EXT
TO MOTHER BD.
FM IN TO SYNTH
MOD SIGNAL TO DISPLAY
AM OUT
OUTPUT LEVEL
TO SYNTH
REMOTE
FM CW AM MOD MODE

FIGURE 7-17
MODULATION CONTROL PCB (A3A3)
SCHEMATIC DIAGRAM #05788201 Rev B

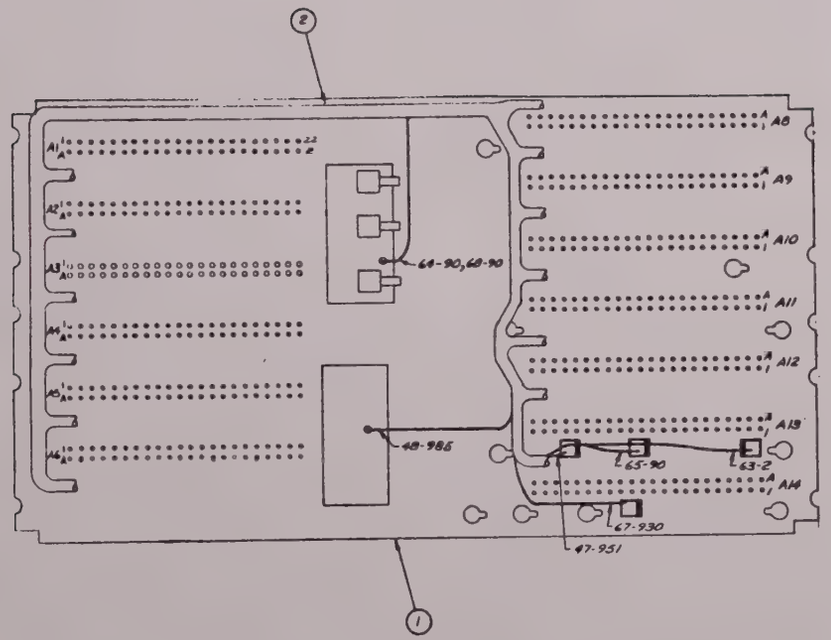


FIGURE 7-18A
MOTHERBOARD/CABLE ASSEMBLY
ASSEMBLY DRAWING #057228 Rev A

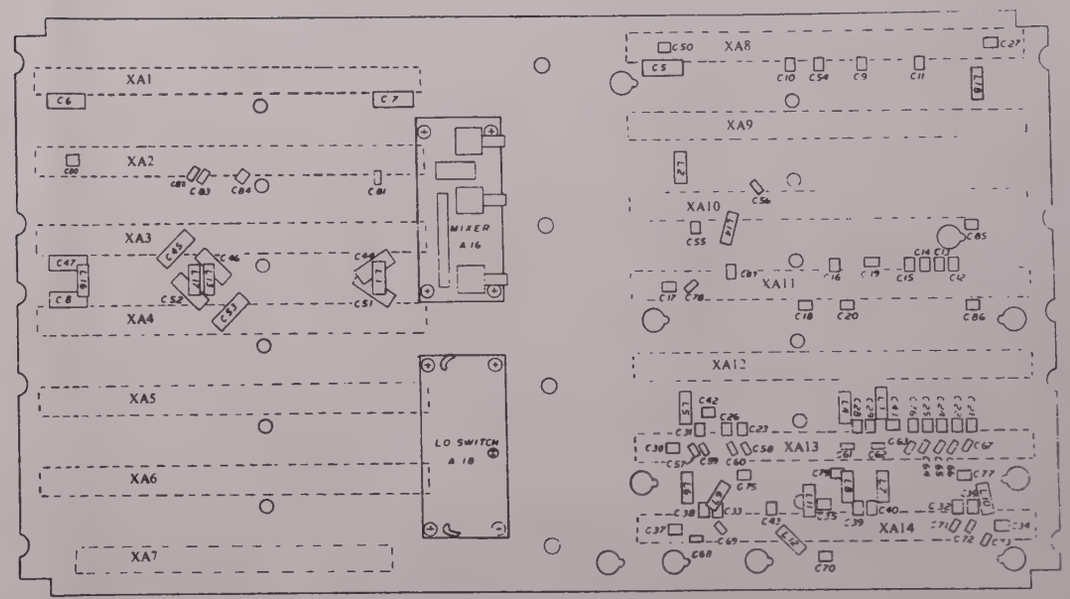
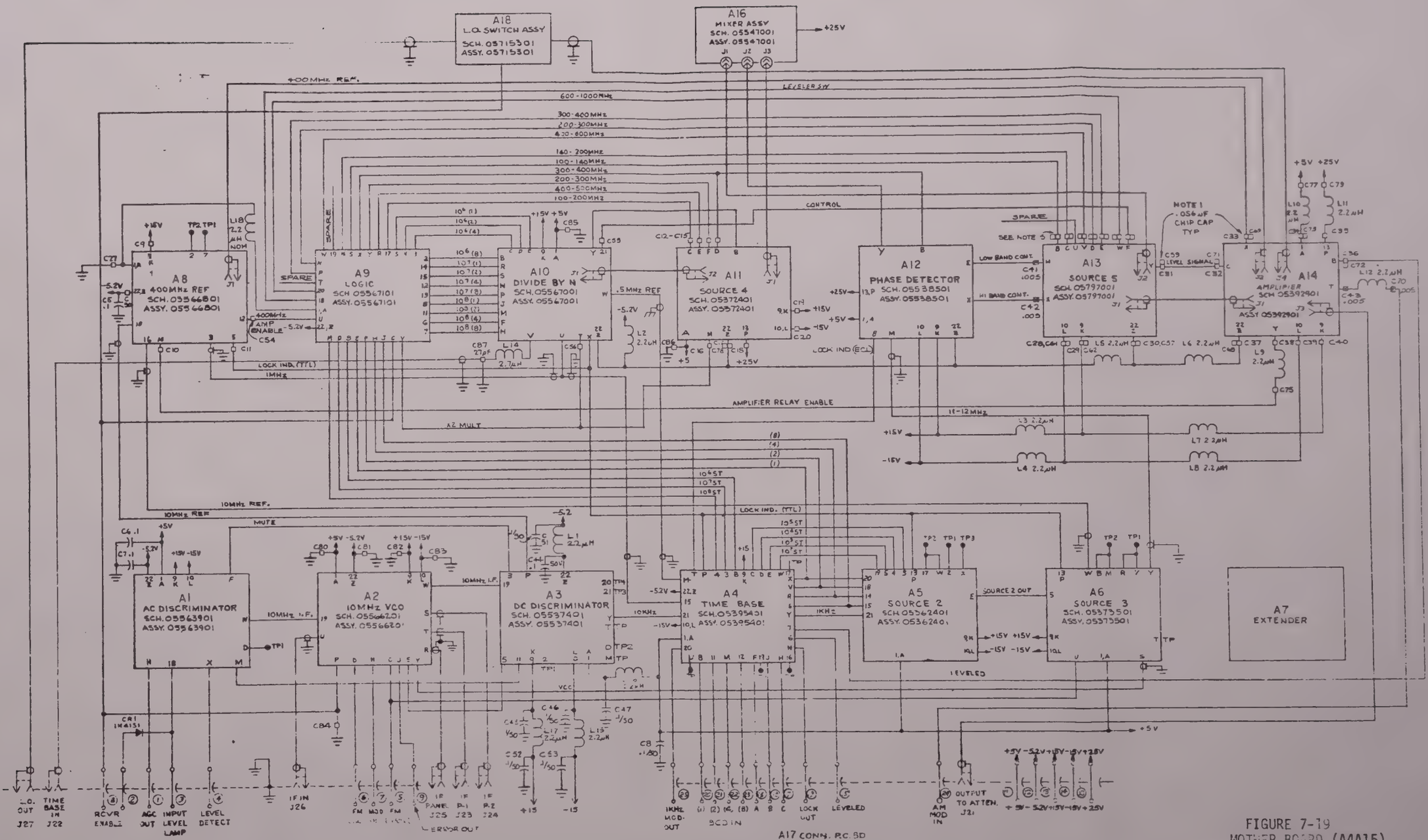


FIGURE 7-18B
MOTHERBOARD (A4A15)
ASSEMBLY DRAWING #05569201 Rev E



NOTES
1) □ INDICATES .056 pF CHIP CAP WHERE MARKED (NO CAP FROM PC CONNECTOR PIN TO GND.
3) ALL DIAGONAL LINES ARE TERMINATED AT BOTTOM OF ...
4) ● INDICATES ... CAP.
5) CHIP CAPS ARE NUMBERED AS FOLLOWS PIN B 21=67 PIN C 22=66 PIN D 24=65 PIN E 25=64 PIN F 26=63 PIN J 23=53 PIN W 24=60.

FIGURE 7-19
MOTHER BOARD (A4A15)
SCHEMATIC DIAGRAM #05569201 Rev B

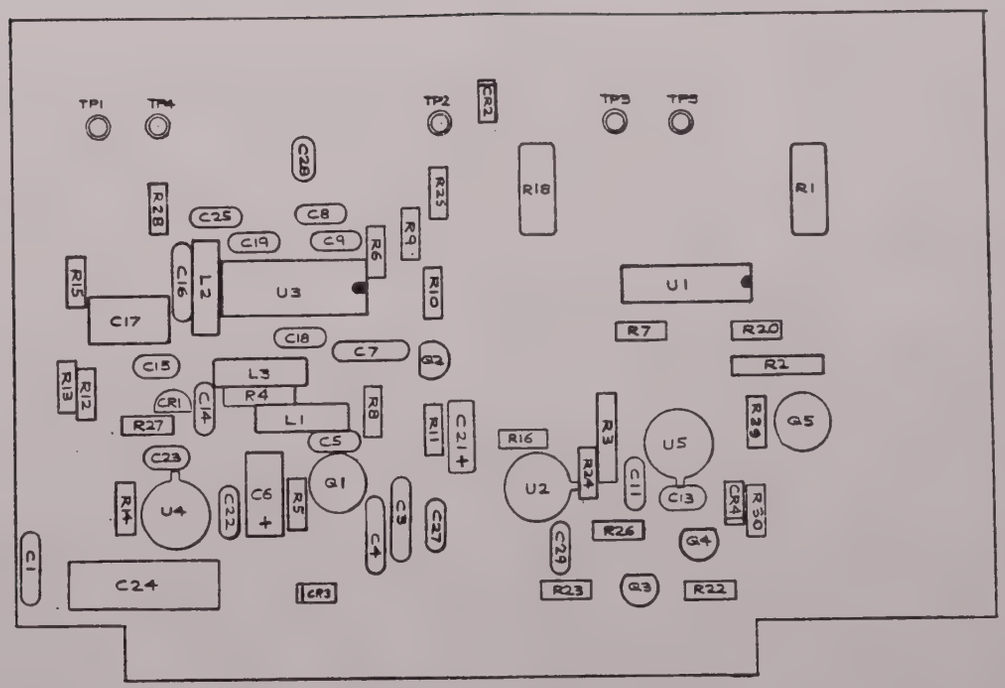
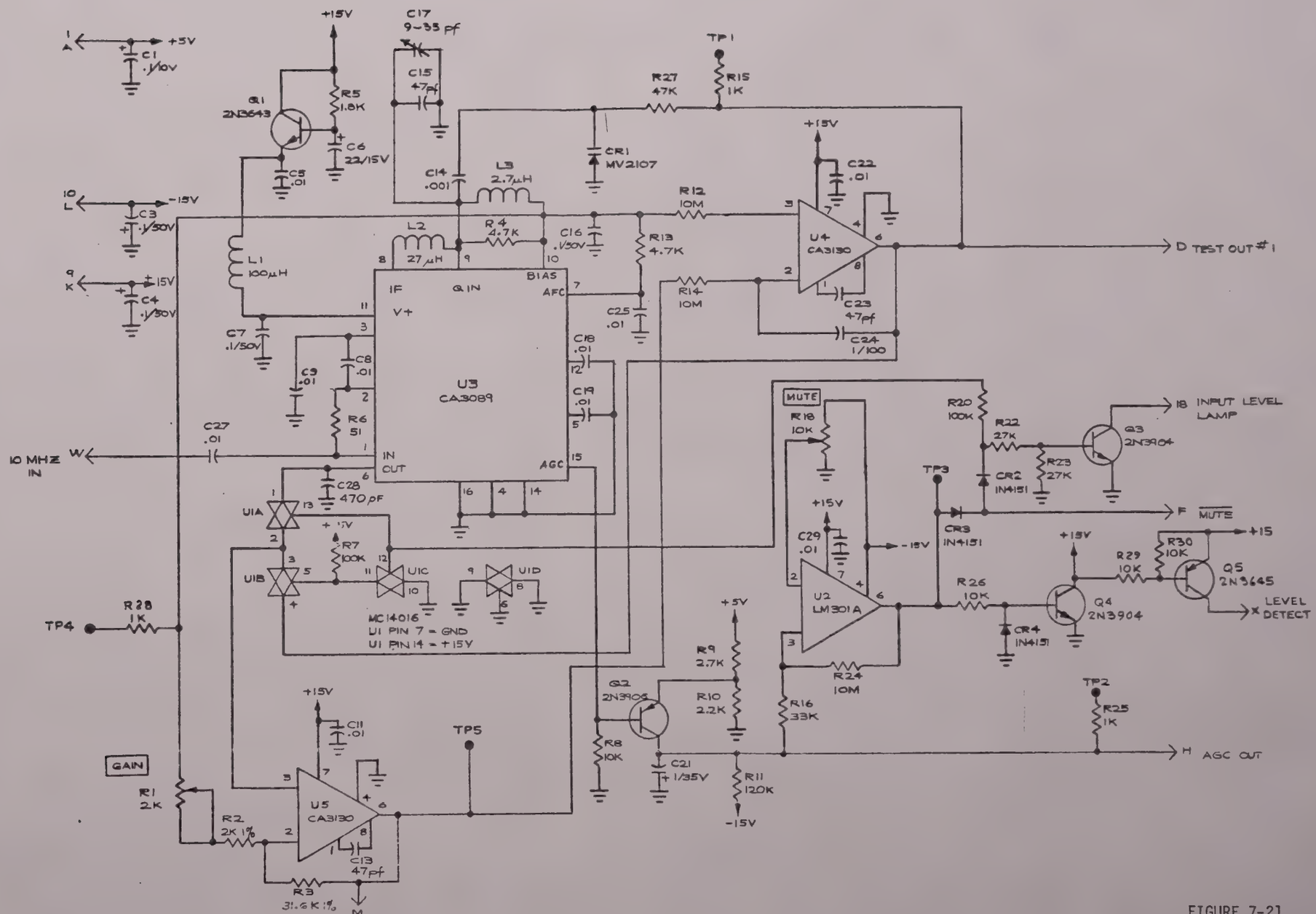


FIGURE 7-20
AC DISCRIMINATOR PCB (A4A1)
ASSEMBLY DRAWING #05563901 Rev D



3. BOXED WORDING INDICATES FRONT PANEL NOMENCLATURE.
2. ALL CAPACITOR VALUES ARE IN µf
ALL RESISTOR VALUES ARE IN OHMS 1/4W 5%
UNLESS OTHERWISE SPECIFIED

FIGURE 7-21
AC DISCRIMINATOR PCB (A4A1)
SCHEMATIC DIAGRAM 05563901 Rev C

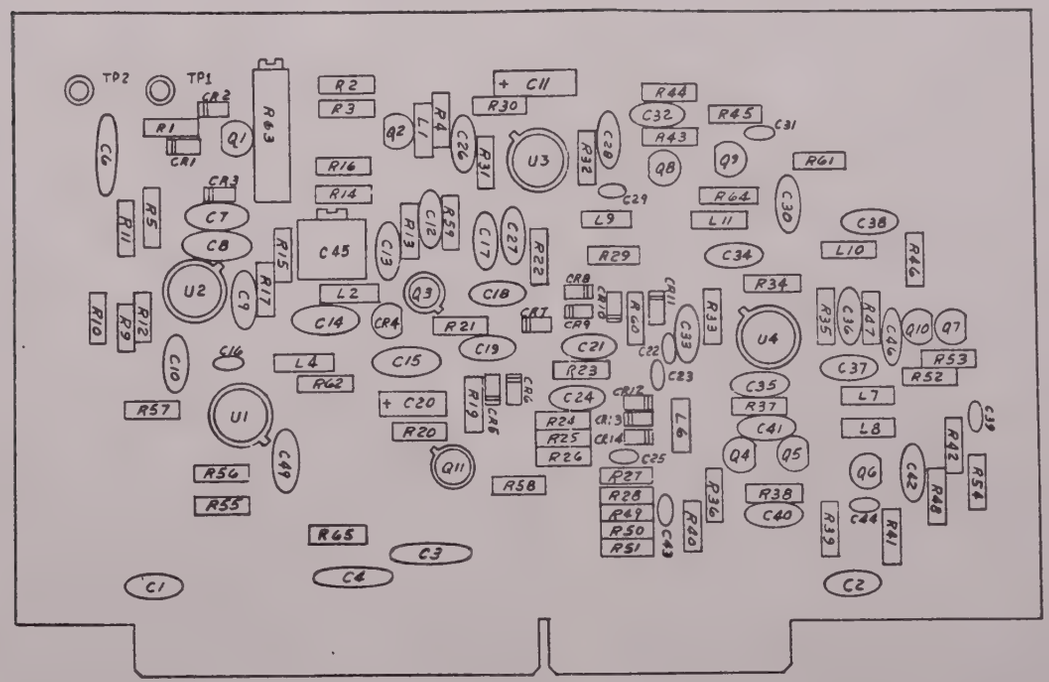
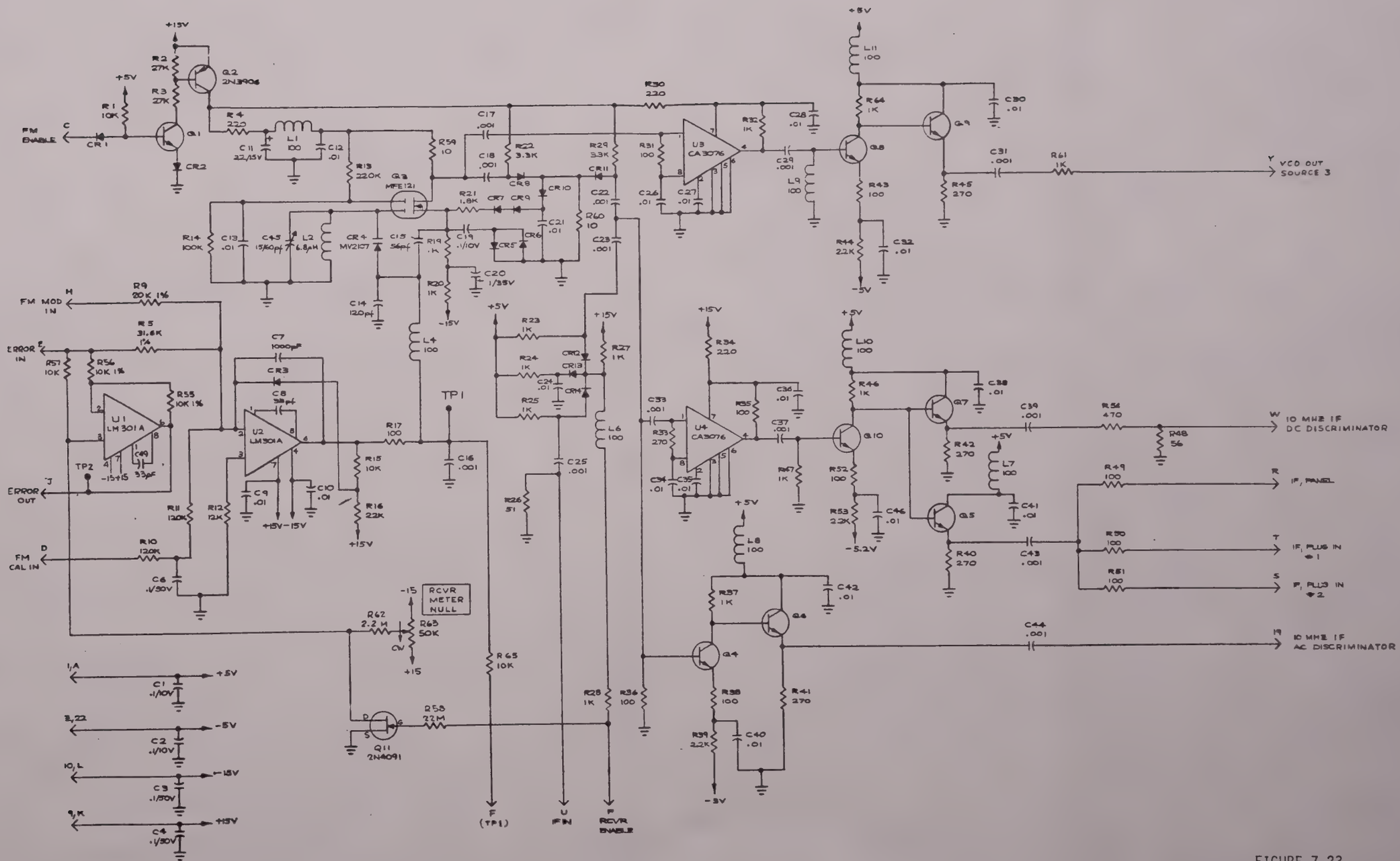


FIGURE 7-22
10 MHz VCO PCB (A4A2)
ASSEMBLY DRAWING #05566201 Rev E



5. ALL INDUCTORS ARE IN μH
4. ALL DIODES ARE 1N4151
3. TRANSISTORS ARE 2N3904
2. ALL CAPACITOR VALUES ARE IN μF
1. ALL RESISTOR VALUES ARE IN OHMS 1/4W 5%

NOTES: UNLESS OTHERWISE SPECIFIED

FIGURE 7-23
10 MHz VCO PCB (A4A2)
SCHEMATIC DIAGRAM #05566201 Rev B

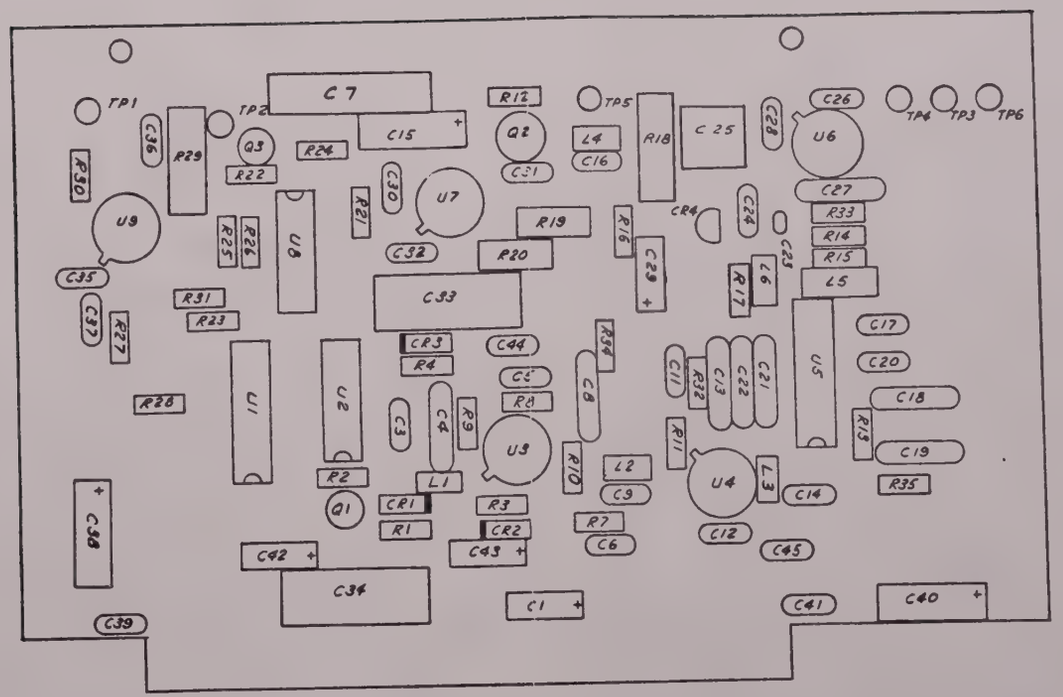


FIGURE 7-24
DC DISCRIMINATOR PCB (A4A3)
ASSEMBLY DIAGRAM #05537401 Rev E

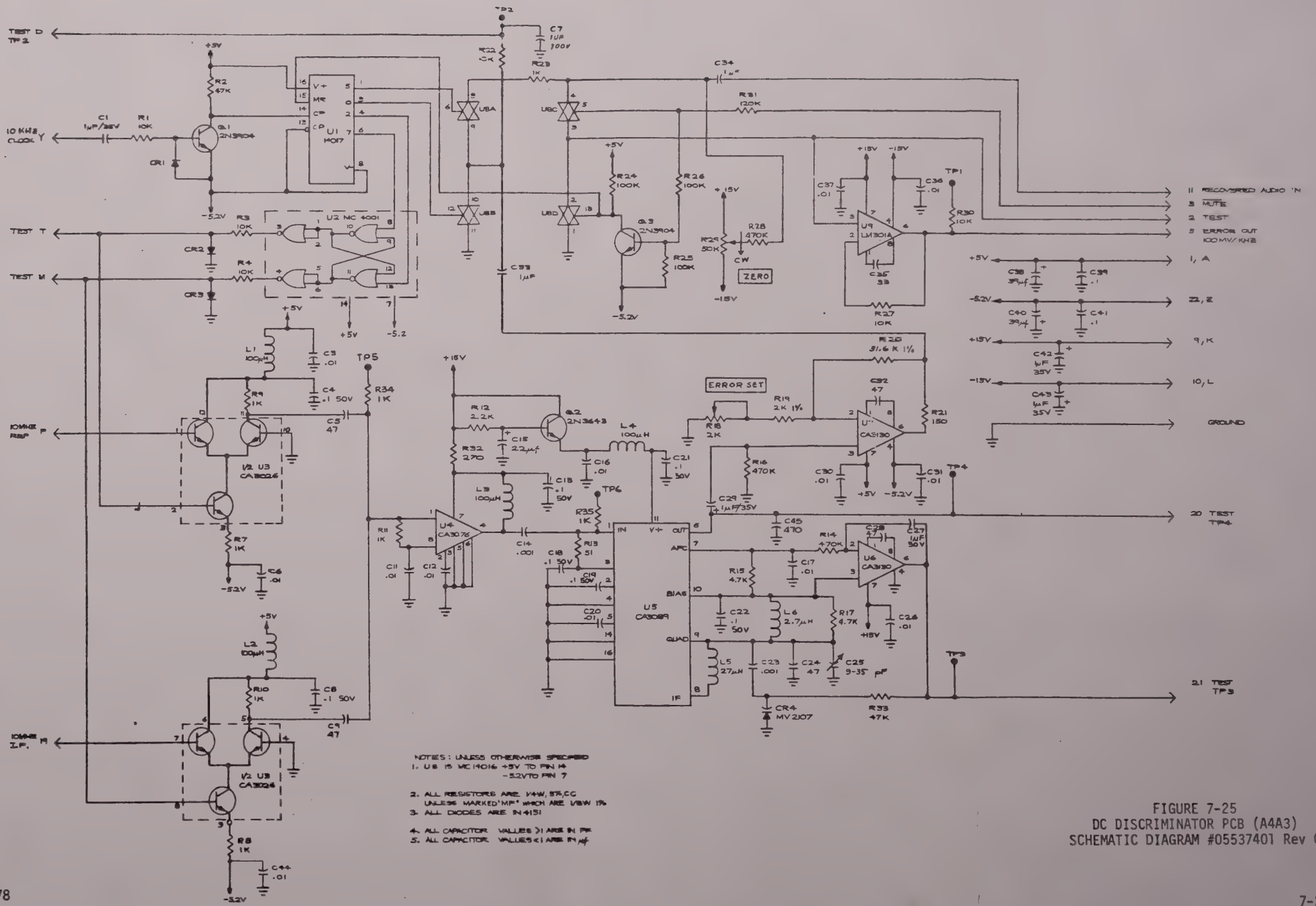


FIGURE 7-25
DC DISCRIMINATOR PCB (A4A3)
SCHEMATIC DIAGRAM #05537401 Rev C

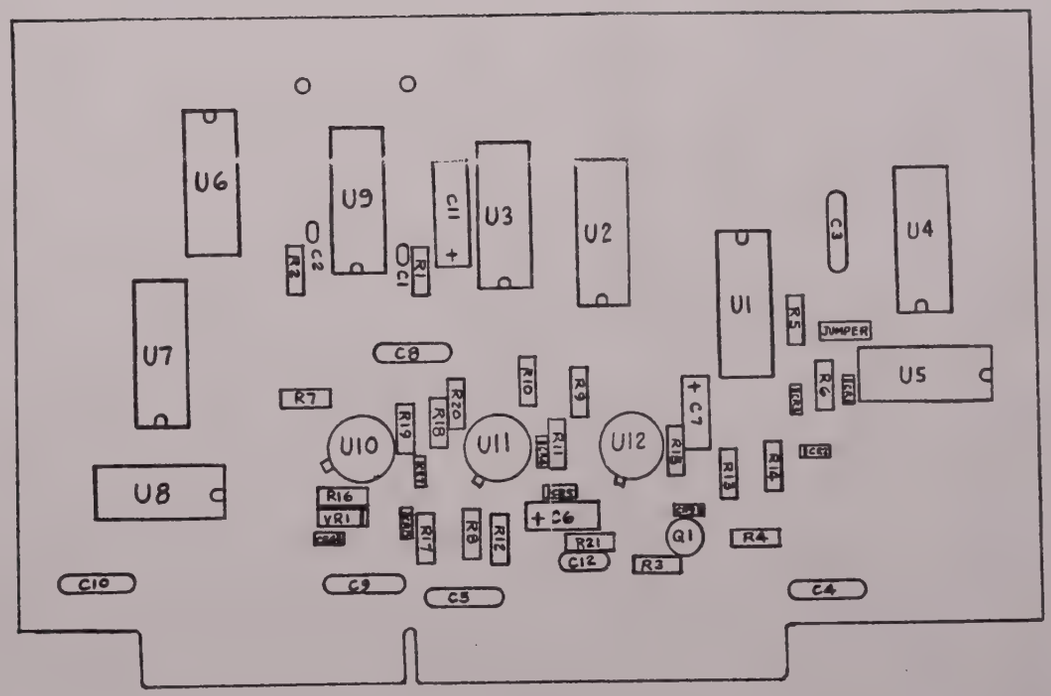
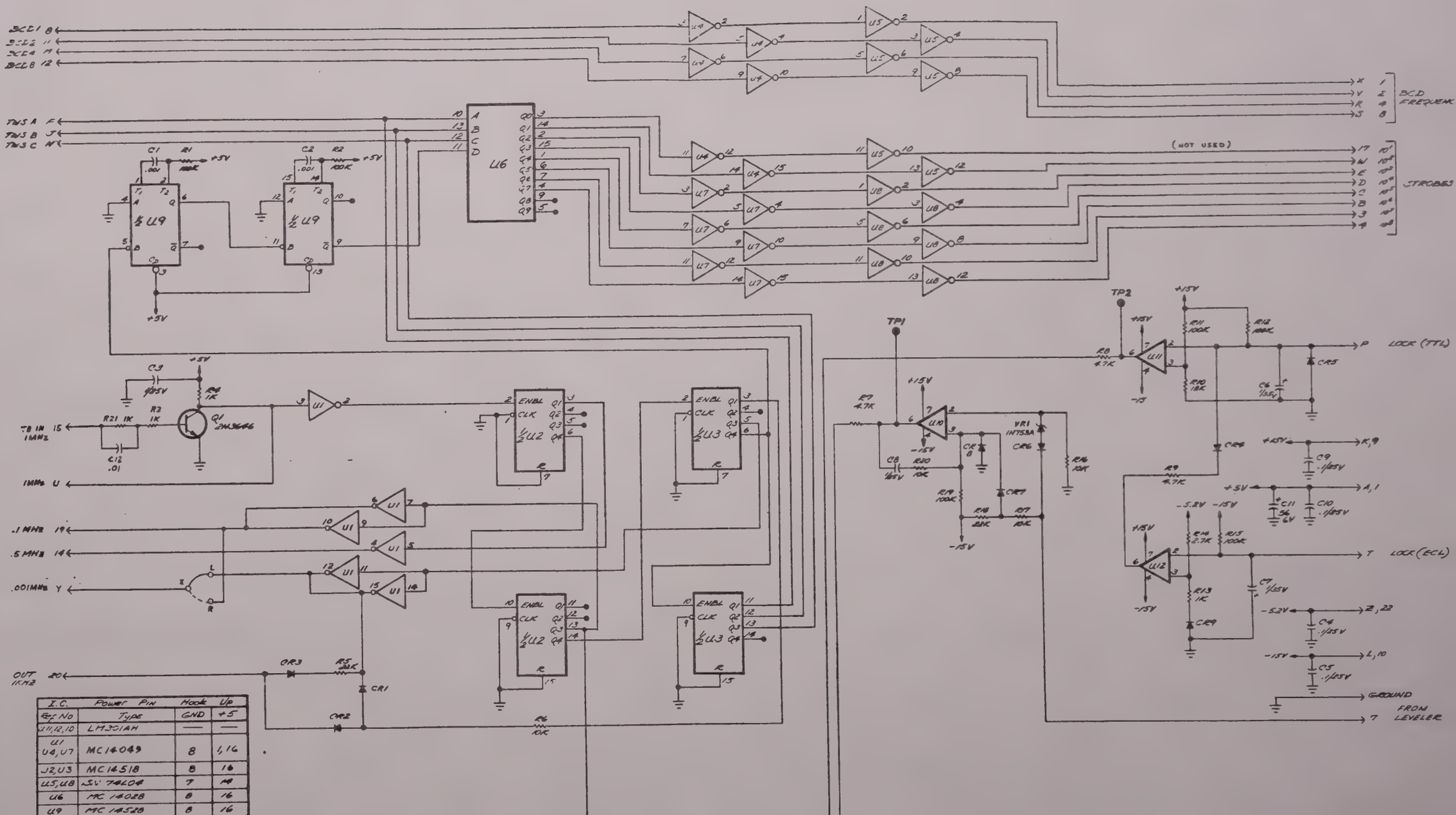


FIGURE 7-26
TIME BASE DIVIDER PCB (A4A4)
ASSEMBLY DRAWING #05395401 Rev C



I.C. Ref No	Power Pin Type	Hook Up GND	Hook Up +5
U11,12,10	LM301AH	—	—
U1 U4,U7	MC14049	8	1,16
U2,U3	MC14518	8	16
U5,U8	SN 74L04	7	14
U6	MC 14028	8	16
U9	MC 14528	8	16

NOTE: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS VALUES ARE IN OHMS, ¼ W, 5%.
2. ALL DIODES ARE IN4151.
3. U10, U11, U12 ARE LM301AN.
4. ALL CAPACITOR VALUES ARE IN μF.

FIGURE 7-27
TIME BASE DIVIDER PCB (A4A4)
SCHEMATIC DIAGRAM #05395401 Rev C

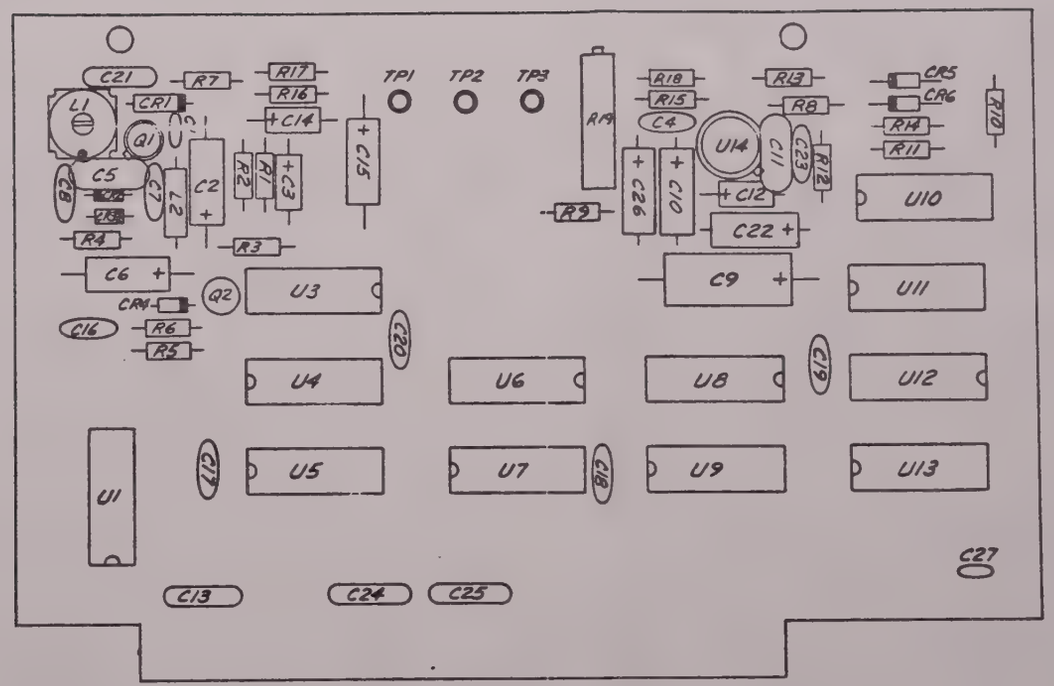
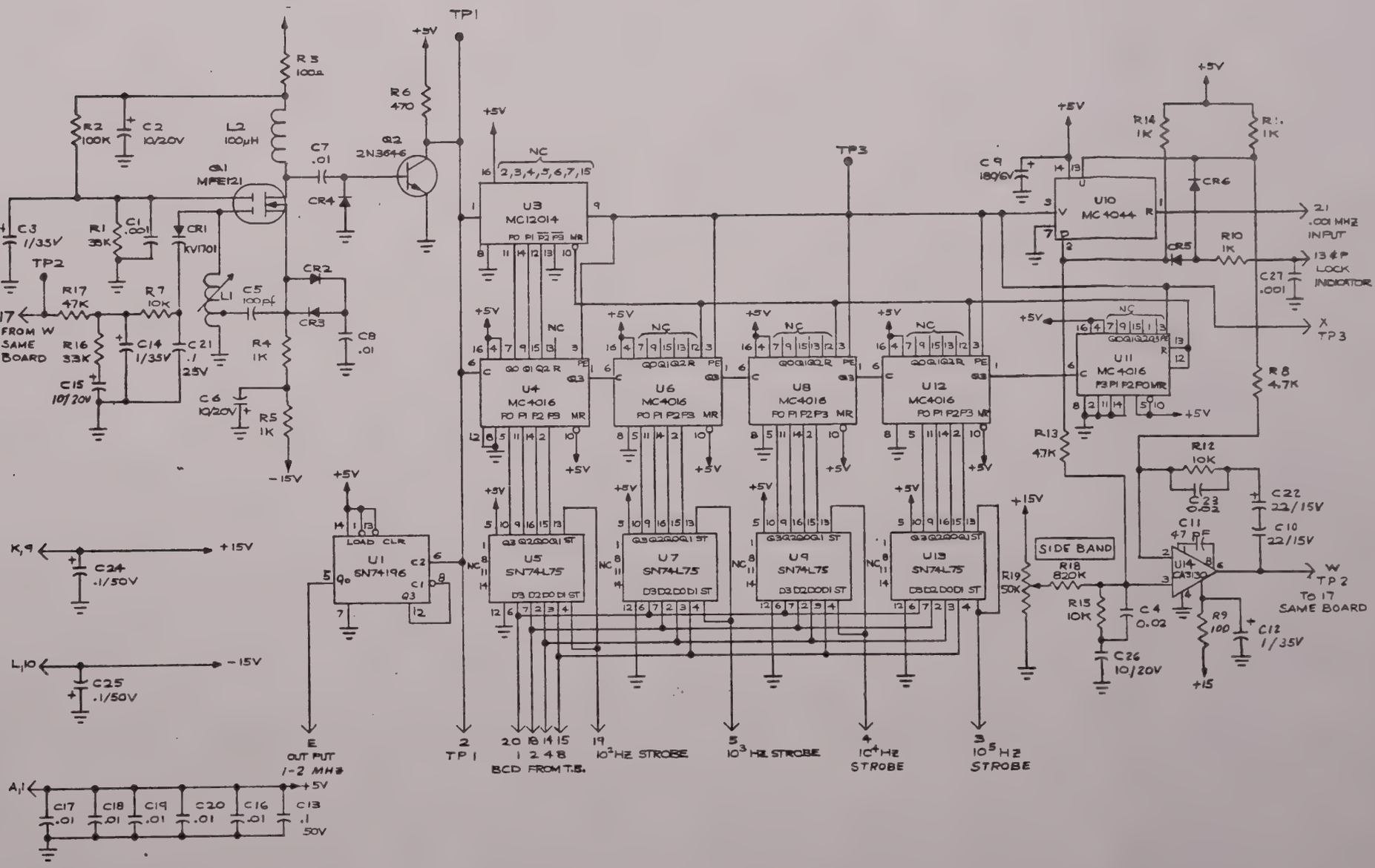


FIGURE 7-28
SOURCE 2 PCB (A4A5)
ASSEMBLY DRAWING #05362401 Rev B



2. ALL CAPACITOR VALUES ARE IN µf
1. ALL RESISTOR VALUES ARE IN OHMS 1/4W 5%
NOTE: UNLESS OTHERWISE SPECIFIED

FIGURE 7-29
SOURCE 2 PCB (A4A5)
SCHEMATIC DIAGRAM #05362401 Rev B

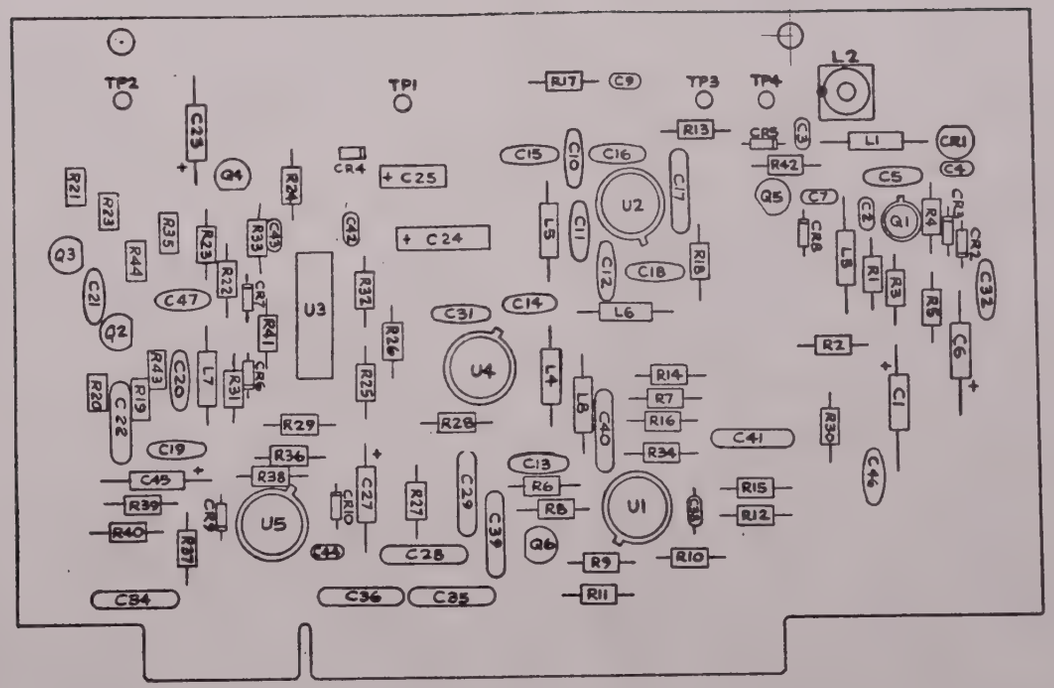
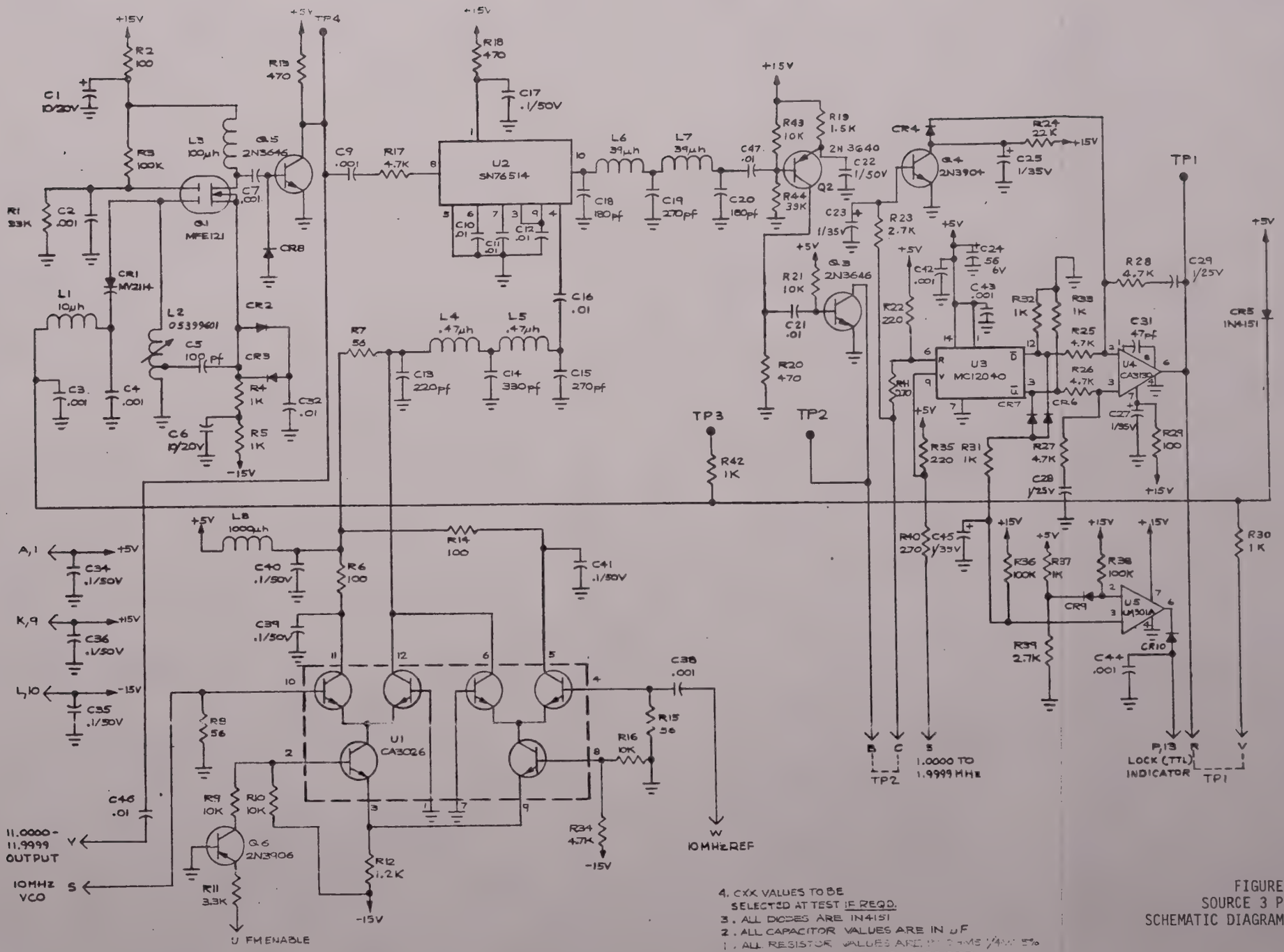


FIGURE 7-30
SOURCE 3 PCB (A4A6)
ASSEMBLY DRAWING #05373501 Rev F



4. CXX VALUES TO BE SELECTED AT TEST IF REQD.
3. ALL DIODES ARE IN4151
2. ALL CAPACITOR VALUES ARE IN µF
1. ALL RESISTOR VALUES ARE IN OHMS 1/4W 5%
NOTE : UNLESS OTHERWISE SPECIFIED.

FIGURE 7-31
SOURCE 3 PCB (A4A6)
SCHEMATIC DIAGRAM #05373501 Rev B

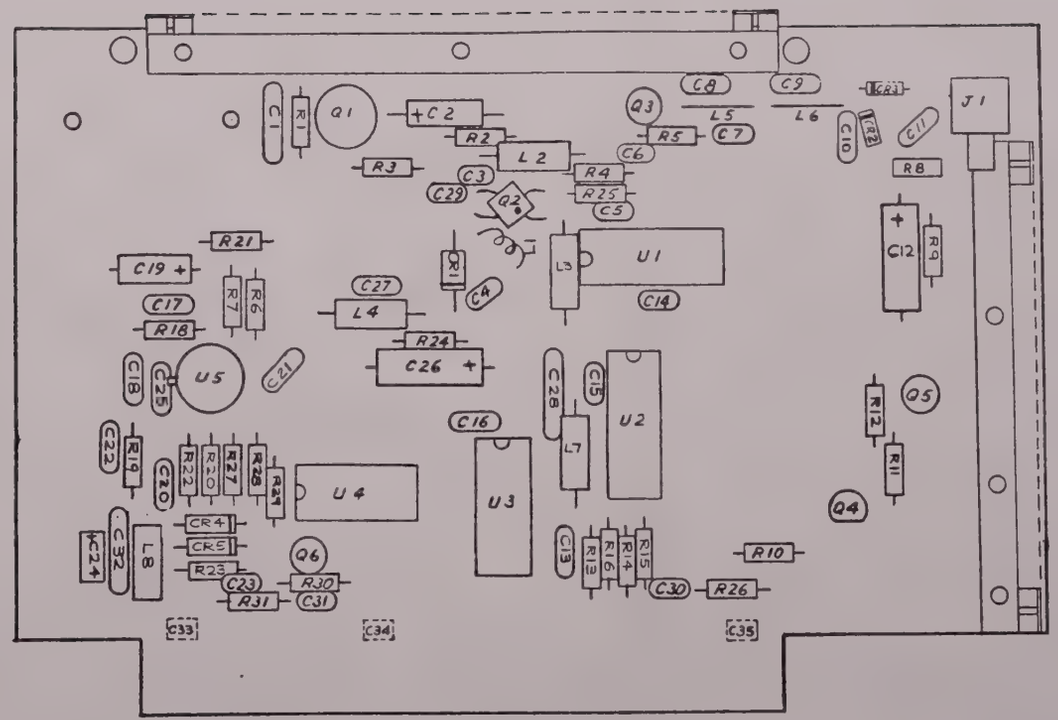
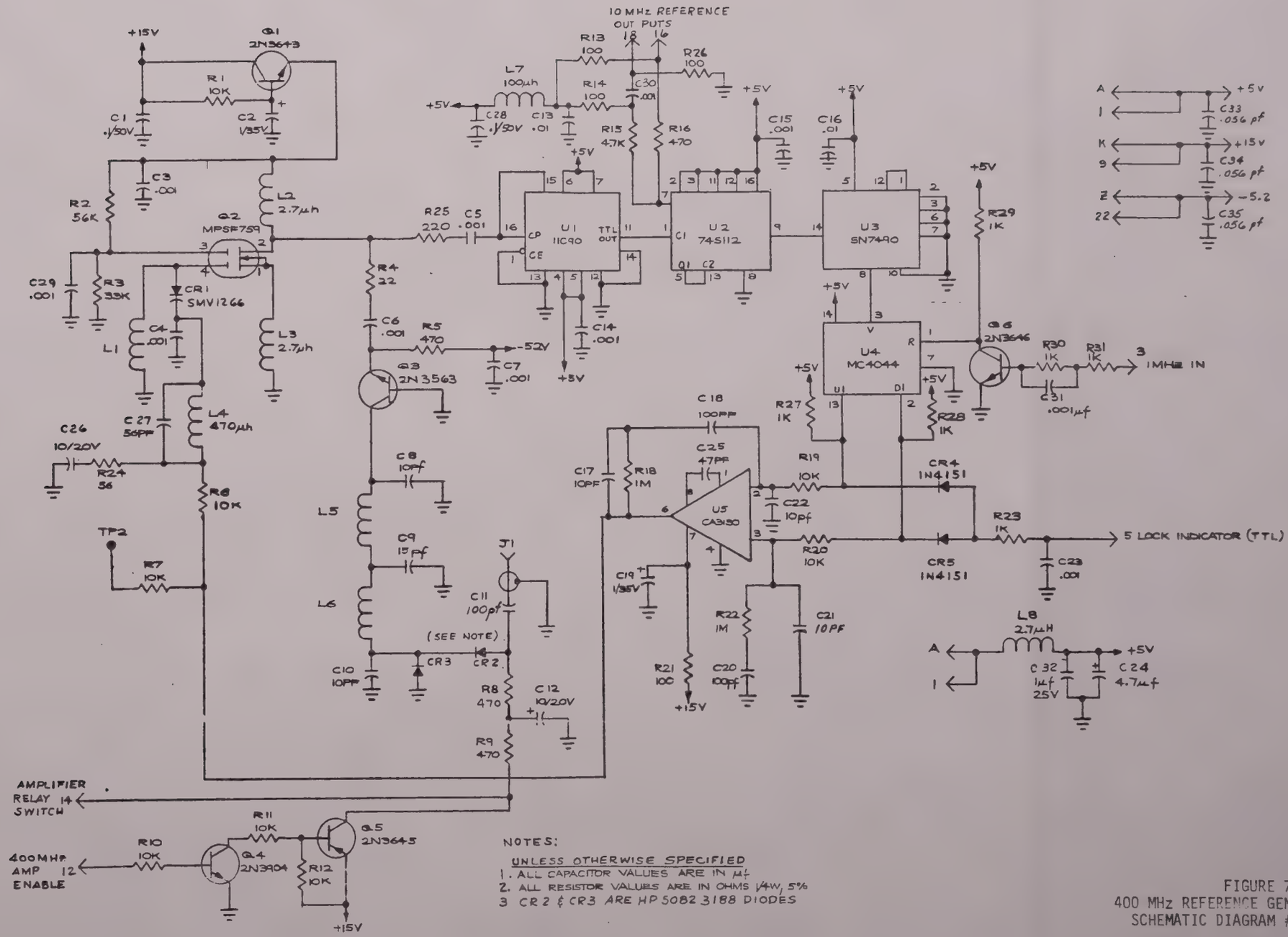


FIGURE 7-32
400 MHz REFERENCE GENERATOR PCB (A4A8)
ASSEMBLY DRAWING #05566801 Rev D



NOTES:

UNLESS OTHERWISE SPECIFIED

1. ALL CAPACITOR VALUES ARE IN µf
2. ALL RESISTOR VALUES ARE IN OHMS 1/4W, 5%
3. CR2 & CR3 ARE HP 5082 3188 DIODES

FIGURE 7-33
400 MHz REFERENCE GENERATOR PCB (A4A8)
SCHEMATIC DIAGRAM #05566801 Rev C

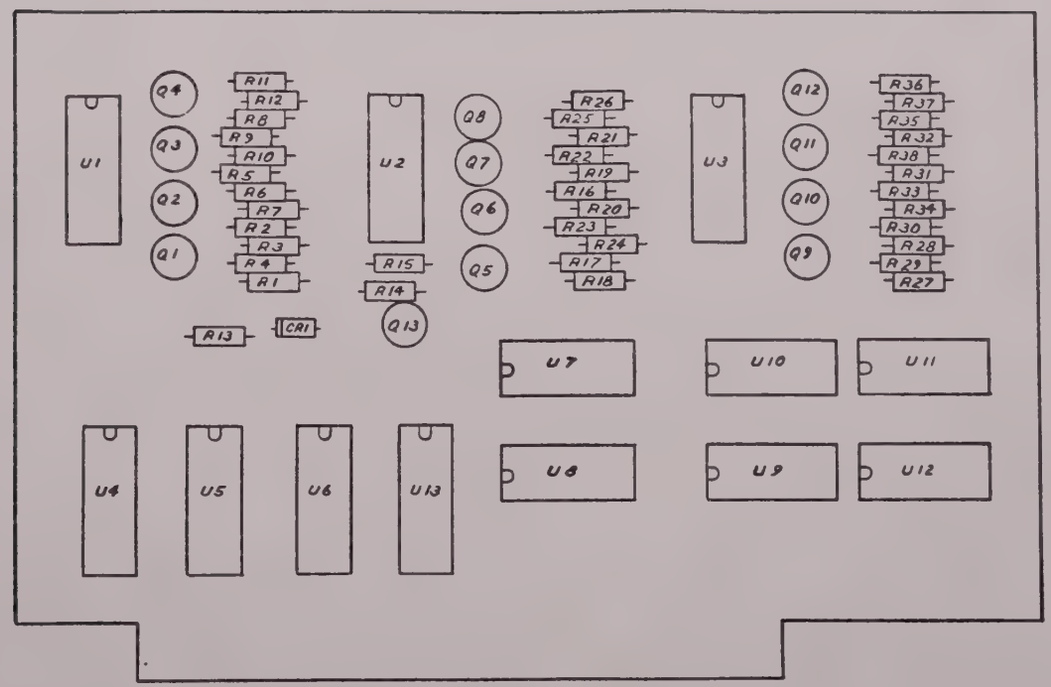
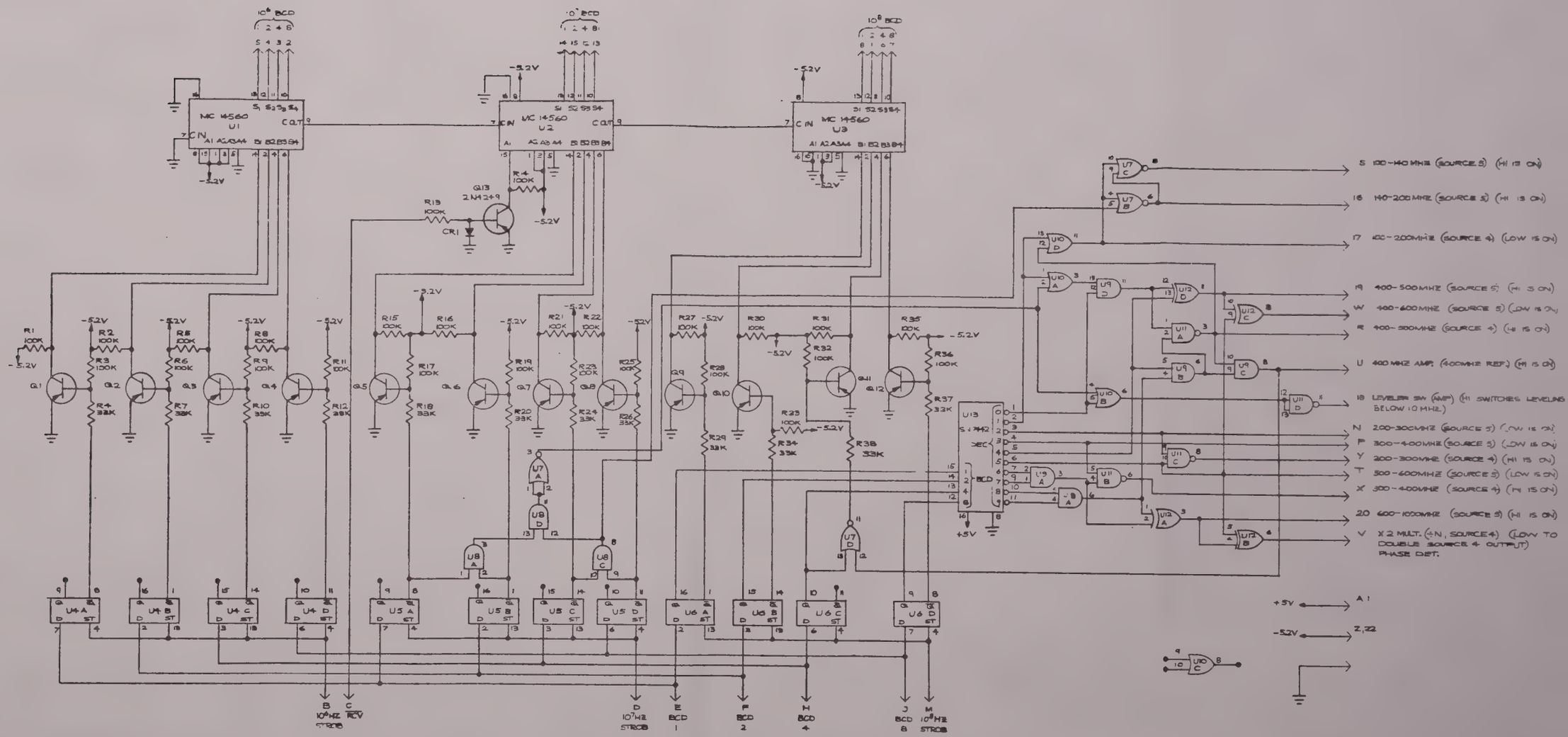


FIGURE 7-34
CONTROL LOGIC PCB (A4A9)
ASSEMBLY DRAWING #05567101 Rev A


MC 14560 U1
MC 14560 U2
MC 14560 U3
-5.2V
+5V
Q1 2N4249
CR1
S 100-140 MHz (SOURCE 3) (HI IS ON)
16 140-200 MHz (SOURCE 3) (HI IS ON)
17 100-200 MHz (SOURCE 4) (LOW IS ON)
19 400-500 MHz (SOURCE 5) (HI IS ON)
W 400-600 MHz (SOURCE 3) (LOW IS ON)
R 400-500 MHz (SOURCE 4) (HI IS ON)
U 400 MHz AMP. (400 MHz REF.) (HI IS ON)
18 LEVELER SW. (AMP) (HI SWITCHES LEVELING BELOW 10 MHz)
N 200-300 MHz (SOURCE 3) (LOW IS ON)
P 300-400 MHz (SOURCE 3) (LOW IS ON)
Y 200-300 MHz (SOURCE 4) (HI IS ON)
T 300-600 MHz (SOURCE 3) (LOW IS ON)
X 300-400 MHz (SOURCE 4) (HI IS ON)
20 600-1000 MHz (SOURCE 3) (HI IS ON)
V X 2 MULT. (-N, SOURCE 4) (LOW TO DOUBLE SOURCE 4 OUTPUT) PHASE DET.
A1
Z,22
B 10⁶ HZ STROBE
C RCV
D 10⁷ HZ STROBE
E BCD 1
F BCD 2
H BCD 4
J BCD 8
M 10⁸ HZ STROBE

REF. DES.	TYPE	PIN NO +5V	PIN NO GND
U4,5,6	74L75N	5	12
U7	MC3002	14	7
U8,9	SN7408N	14	7
U10	SN7432N	14	7
U11	SN7400N	14	7
U12	MC3021	14	7

3. ALL DIODES ARE IN4151
2. ALL TRANSISTORS ARE 2N4249
1. ALL RESISTOR VALUES ARE IN OHMS 1/4W 5%

NOTE : UNLESS OTHERWISE SPECIFIED

FIGURE 7-35
CONTROL LOGIC PCB (A4A9)
SCHEMATIC DIAGRAM #05567101 Rev A

R-1201A•4•78

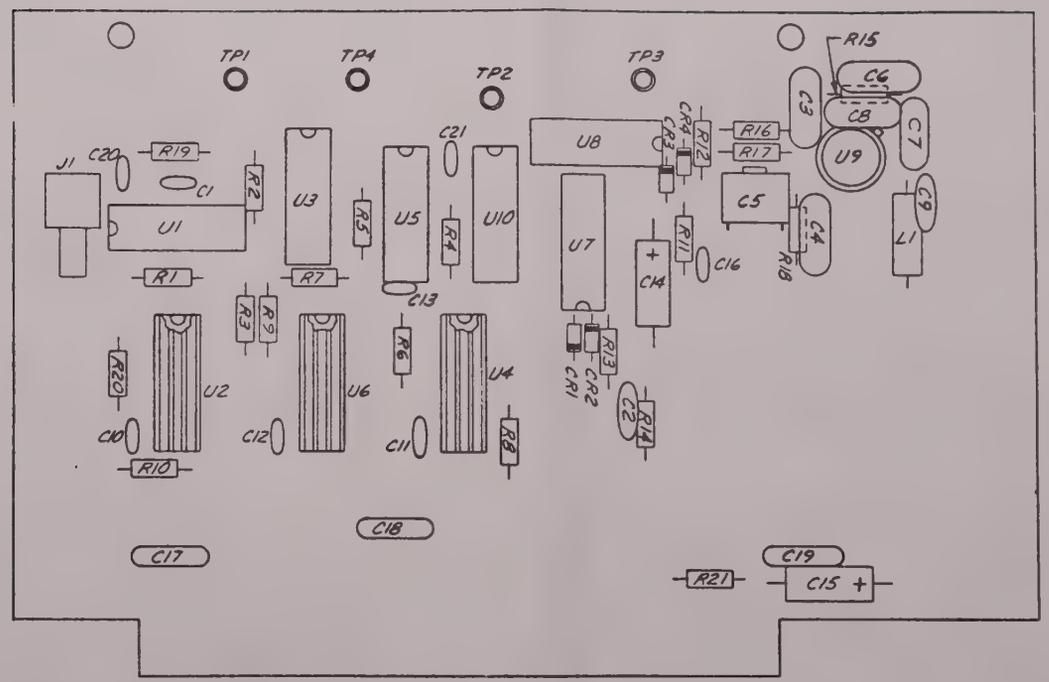
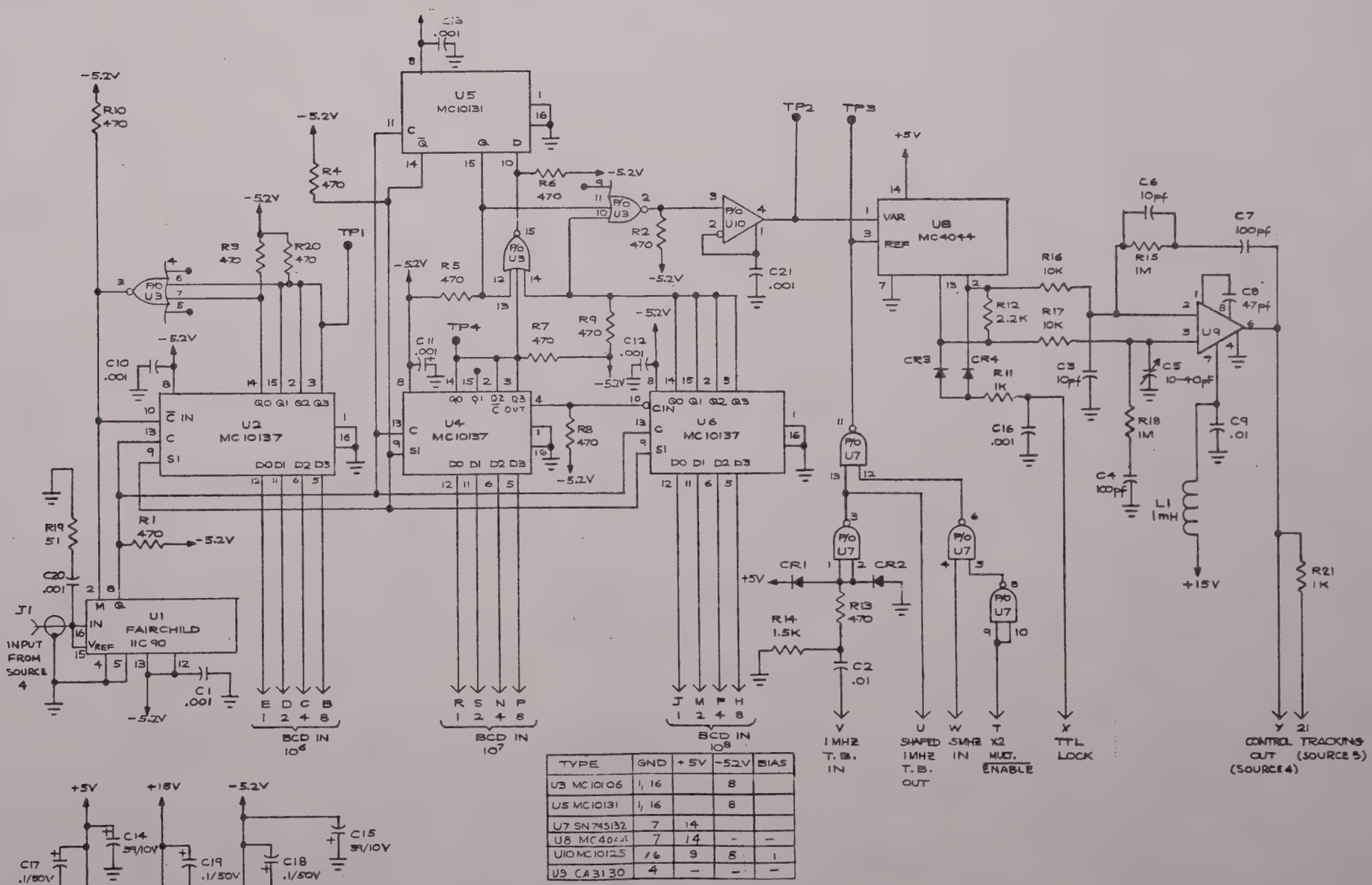


FIGURE 7-36
DIVIDE-BY-N PCB (A4A10)
ASSEMBLY DRAWING #05567001 Rev D

R-1201A•4•78



TYPE	GND	+5V	-5.2V	BIAS
U3 MC10106	1, 16		8	
U5 MC10131	1, 16		8	
U7 SN74S132	7	14		
U8 MC4044	7	14	-	-
U10 MC10125	16	9	8	1
U9 CA3130	4	-	-	-

1. ALL DIODES ARE IN4151
2. ALL CAPACITOR VALUES ARE IN μf
3. ALL RESISTOR VALUES ARE IN OHMS 1/4W 5%

NOTE: UNLESS OTHERWISE SPECIFIED

FIGURE 7-37
DIVIDE-BY-N PCB (A4A10)
SCHEMATIC DIAGRAM #05567001 Rev A

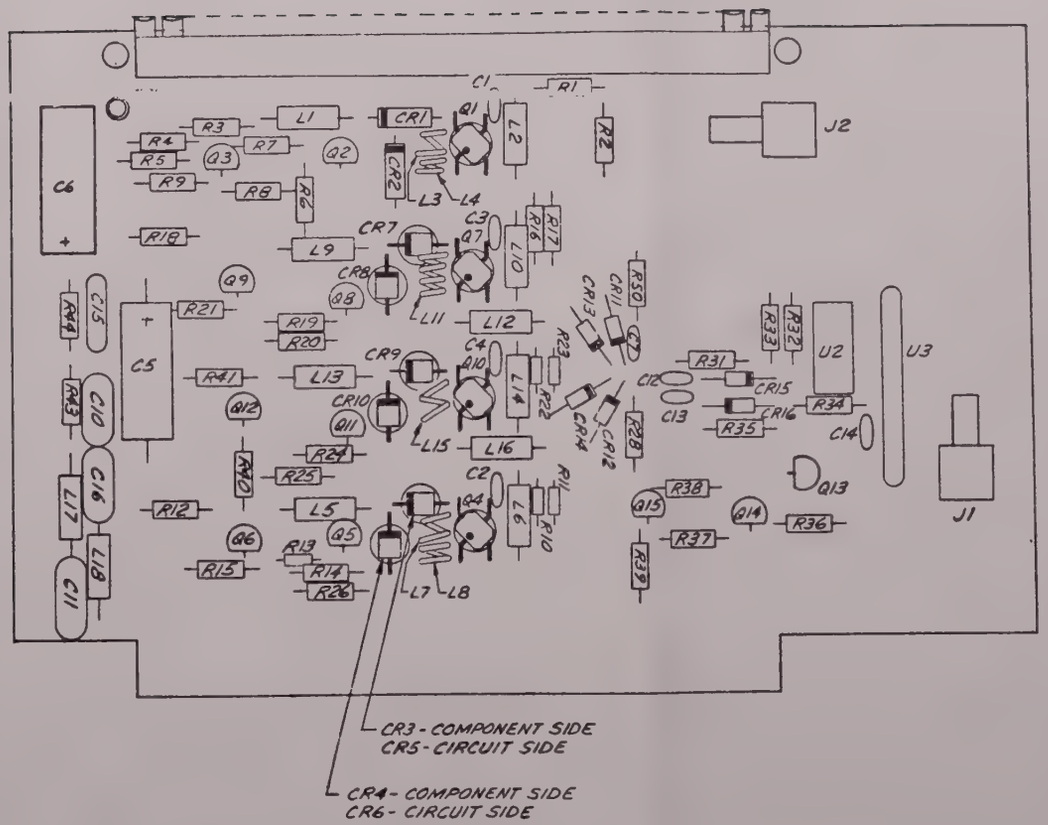
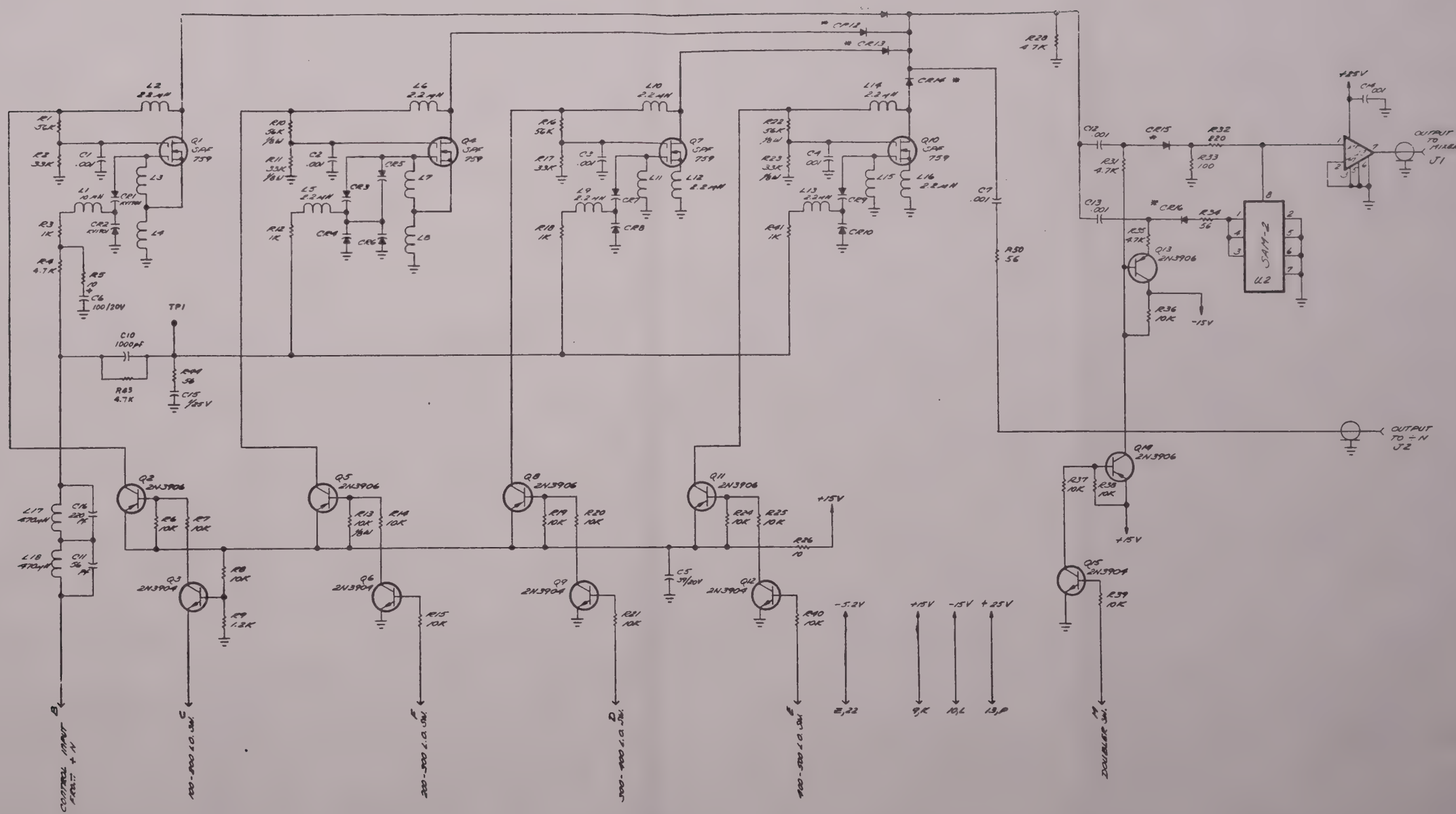


FIGURE 7-38
SOURCE 4 PCB (A4A11)
ASSEMBLY DRAWING #05372401 Rev F



NOTES: UNLESS OTHERWISE SPECIFIED

1) ALL RESISTORS ARE ¼ W, 5 % IN OHMS.
2) ALL CAPACITOR VALUES ARE IN μf.
3) ALL DIODES ARE SMV1246.
4) * DENOTES HP 5082-3188 PIN DIODE.

FIGURE 7-39
SOURCE 4 PCB (A4A11)
SCHEMATIC DIAGRAM #05372401 Rev B

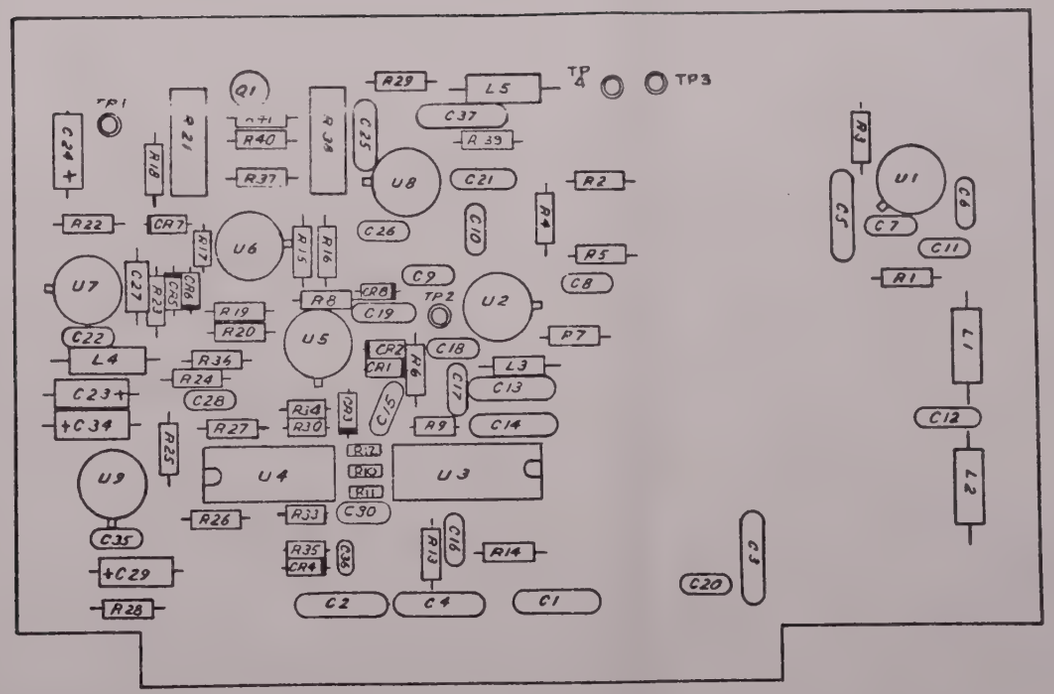


FIGURE 7-40
PHASE DETECTOR PCB (A4A12)
ASSEMBLY DRAWING #05538501 Rev G

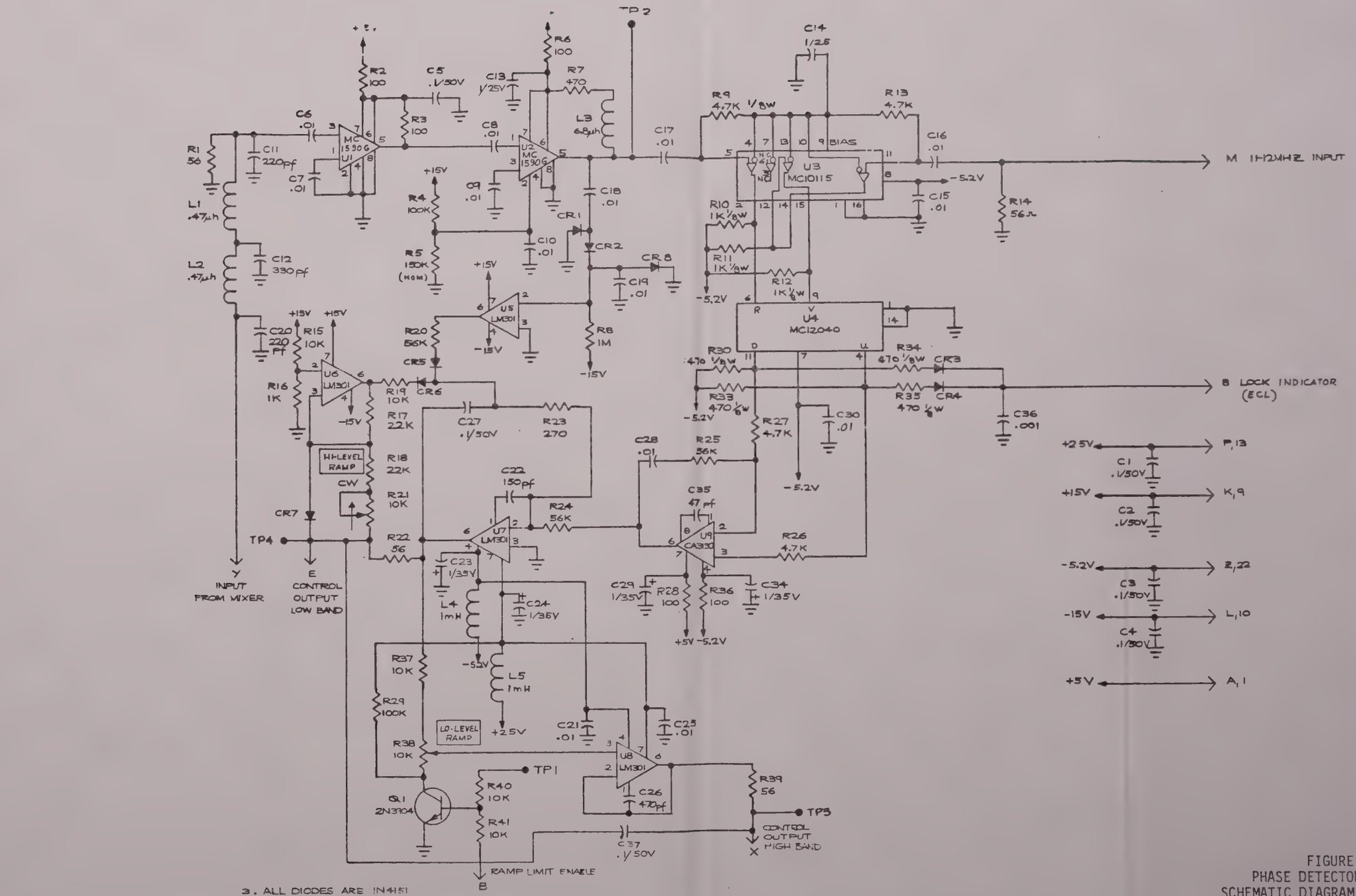


FIGURE 7-41
PHASE DETECTOR PCB (A4A12)
SCHEMATIC DIAGRAM #05538501 Rev B

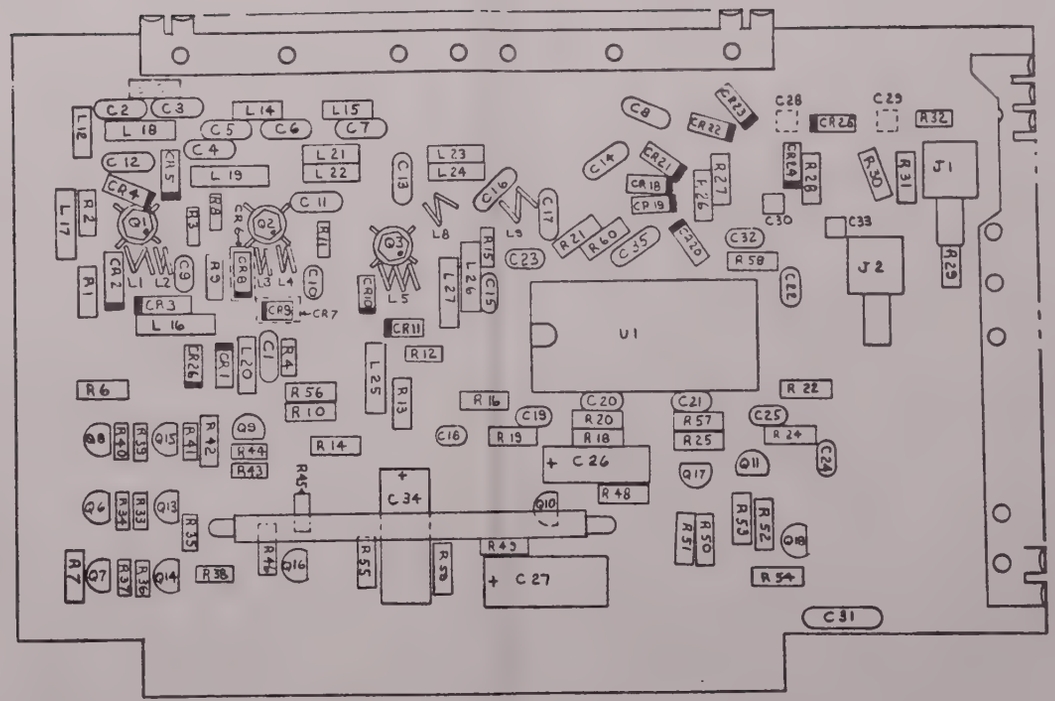


FIGURE 7-42
SOURCE 5 PCB (A4A13)
ASSEMBLY DRAWING #05797001 Rev B

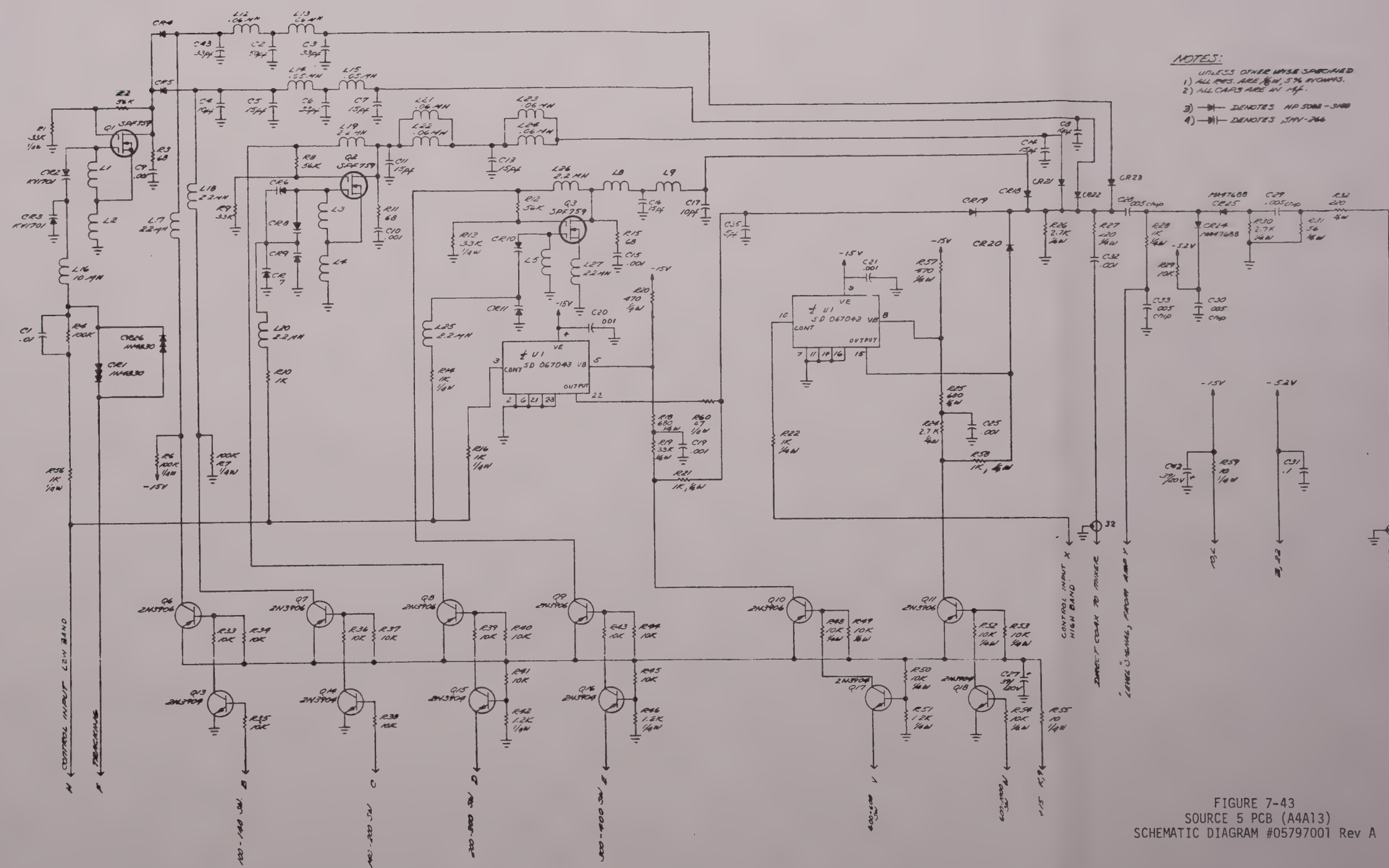


FIGURE 7-43
SOURCE 5 PCB (A4A13)
SCHEMATIC DIAGRAM #05797001 Rev A

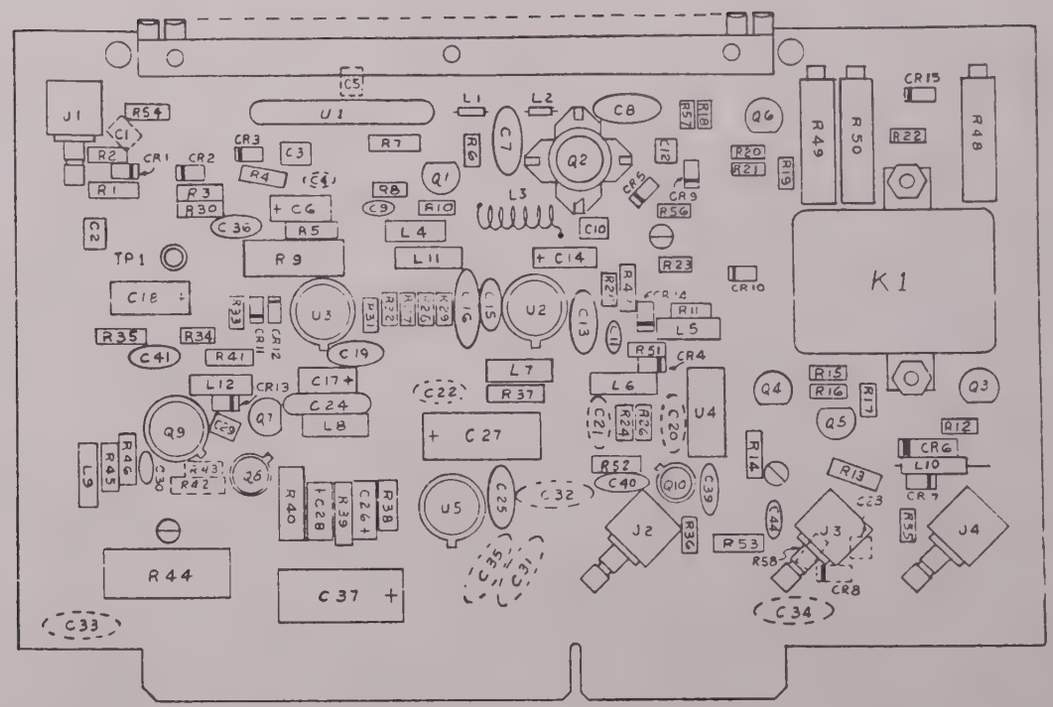


FIGURE 7-44
AMPLIFIER PCB (A4A14)
ASSEMBLY DRAWING #05392901 Rev L

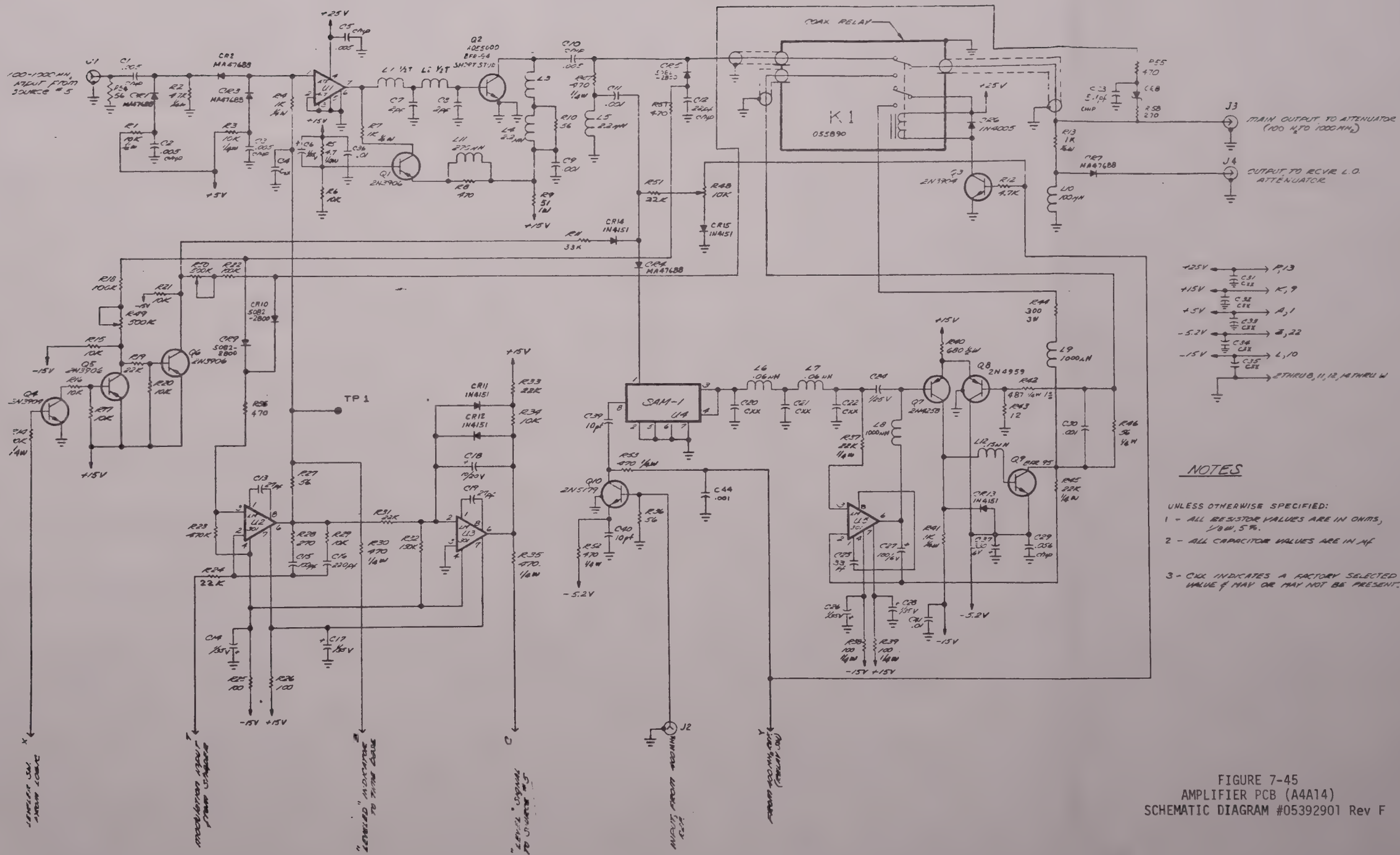
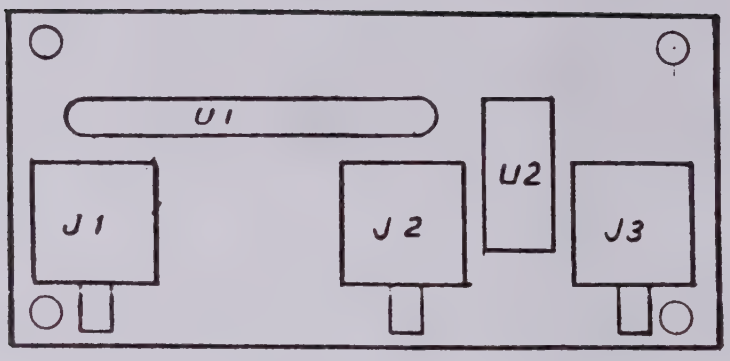
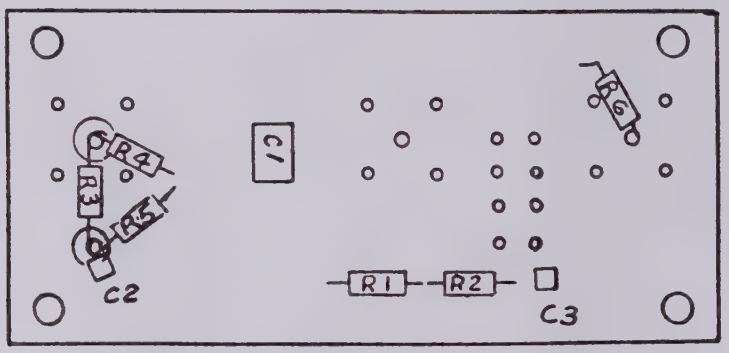


FIGURE 7-45
AMPLIFIER PCB (A4A14)
SCHEMATIC DIAGRAM #05392901 Rev F

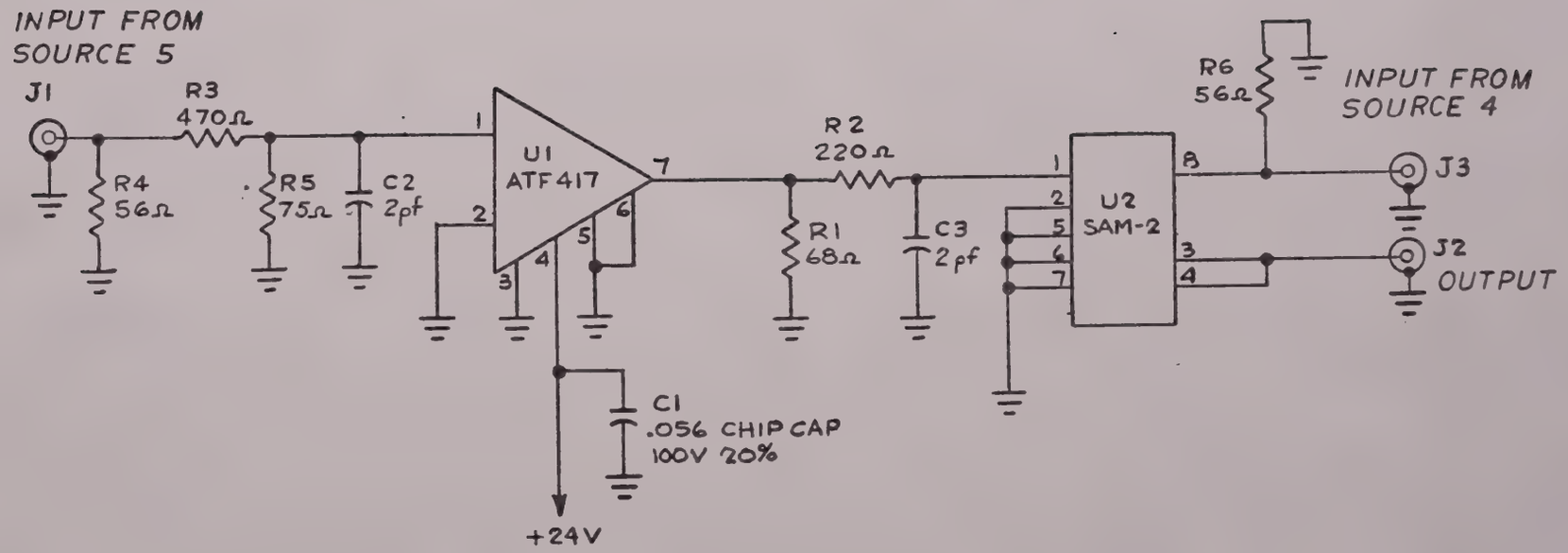


COMPONENT SIDE



CIRCUIT SIDE

FIGURE 7-46
MIXER ASSEMBLY (A4A16)
ASSEMBLY DRAWING #05547001 Rev D



NOTE:
1. UNLESS NOTED: ALL RES. ARE 1/8W, 5%

FIGURE 7-47
MIXER ASSEMBLY (A4A16)
SCHEMATIC DIAGRAM #05547001 Rev A

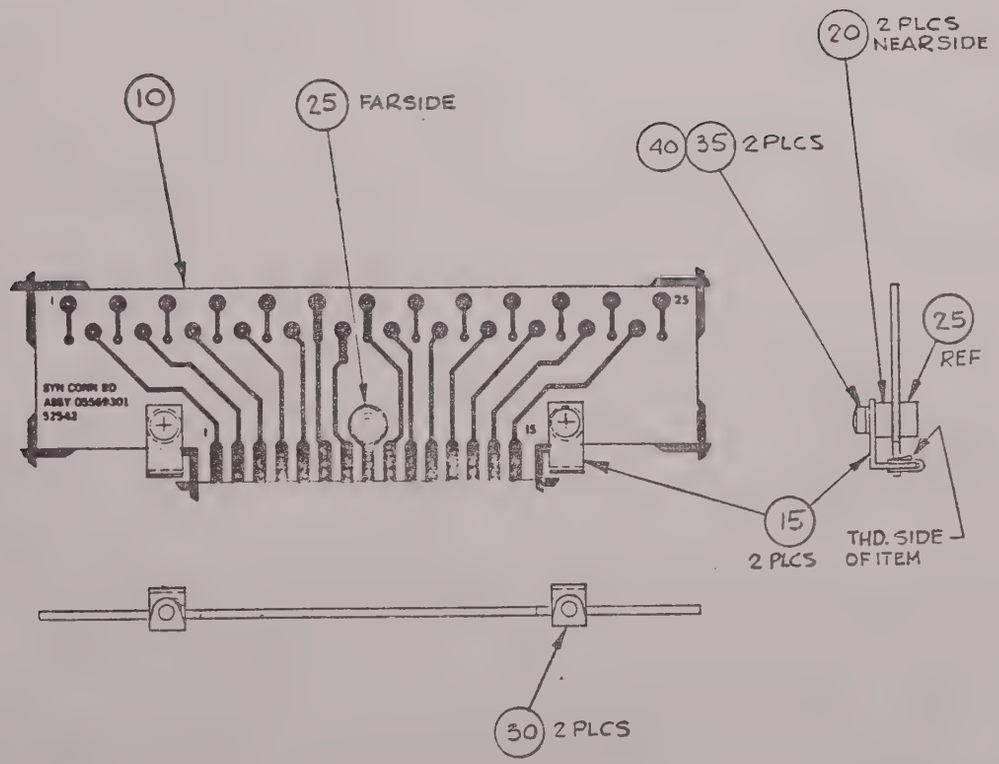


FIGURE 7-48
CONNECTOR BOARD (A4A17)
ASSEMBLY DRAWING #05569301 Rev A

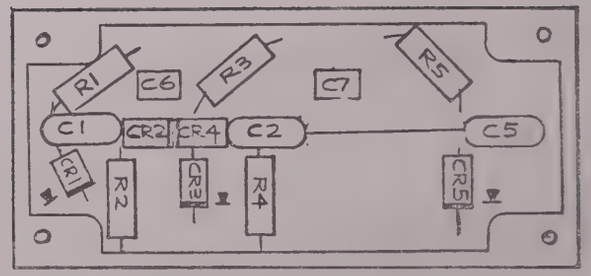
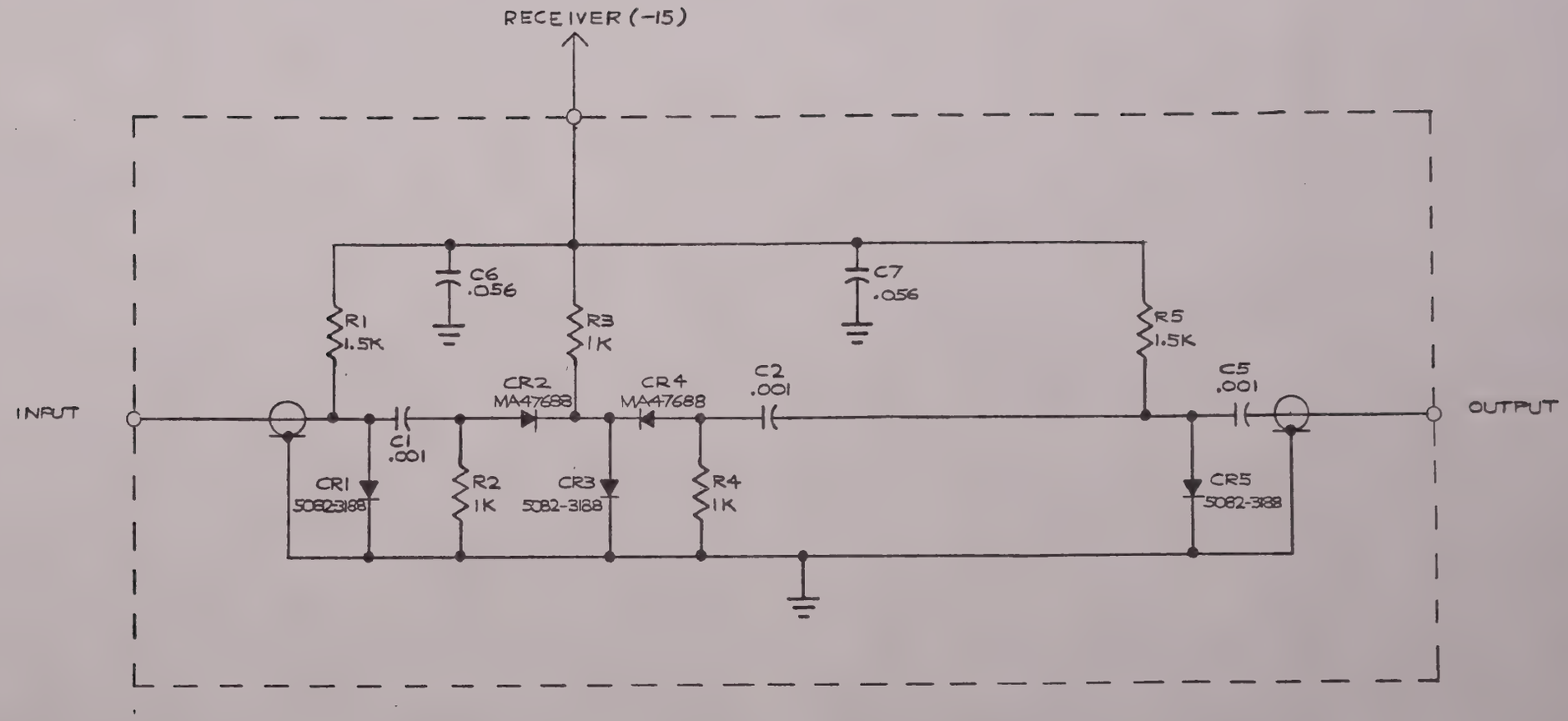


FIGURE 7-49
L.O. SWITCH PCB (A4A18)
ASSEMBLY DRAWING #05715301 Rev B



NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS 1/4W, 5%
2. ALL CAPACITOR VALUES ARE IN uf

FIGURE 7-50
L.O. SWITCH PCB (A4A18)
SCHEMATIC DIAGRAM #05715301 Rev B

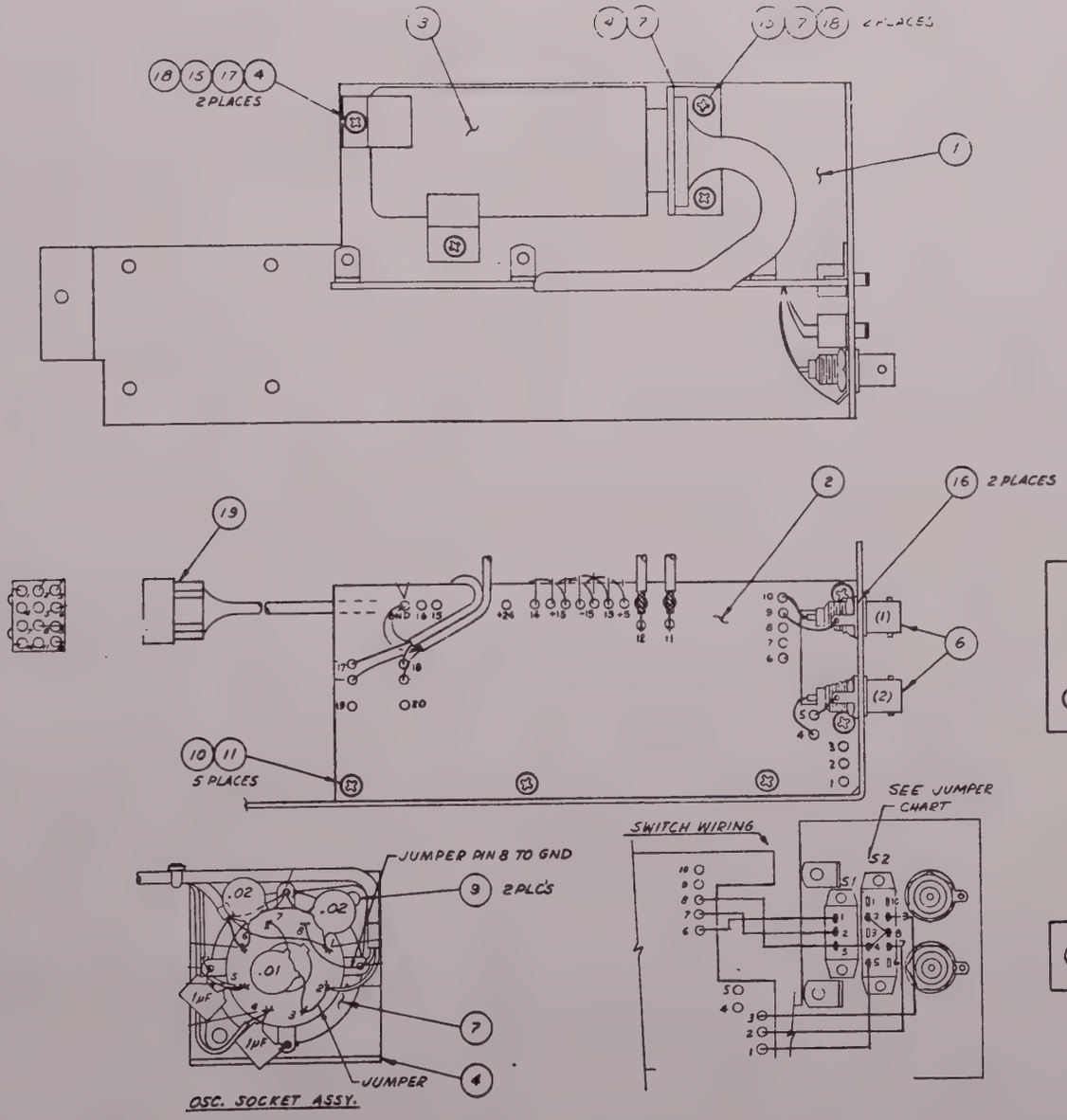


FIGURE 7-51
STD CLOCK OSCILLATOR (A5)
ASSEMBLY DRAWING #05756001 Rev E

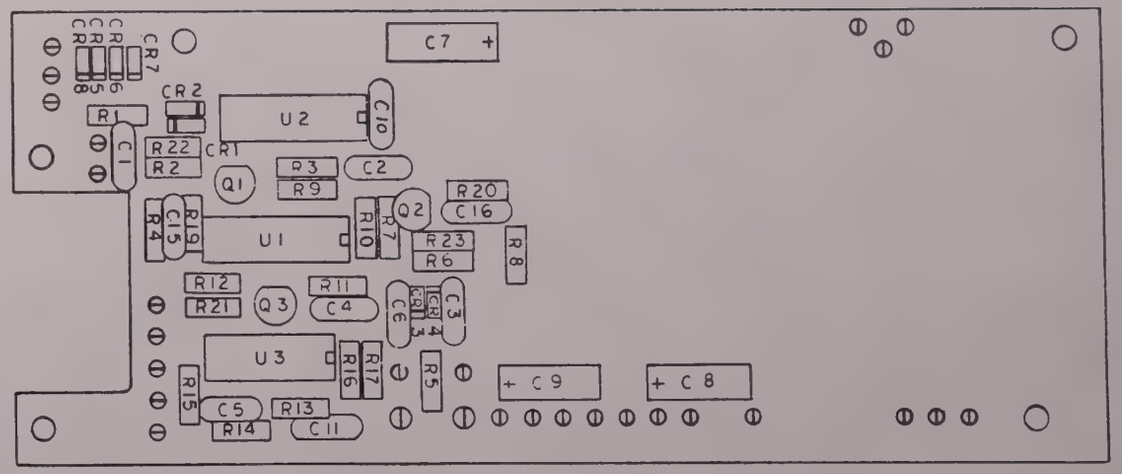


FIGURE 7-52
OSCILLATOR CONTROL (A5A1)
ASSEMBLY DRAWING #05754001 Rev B

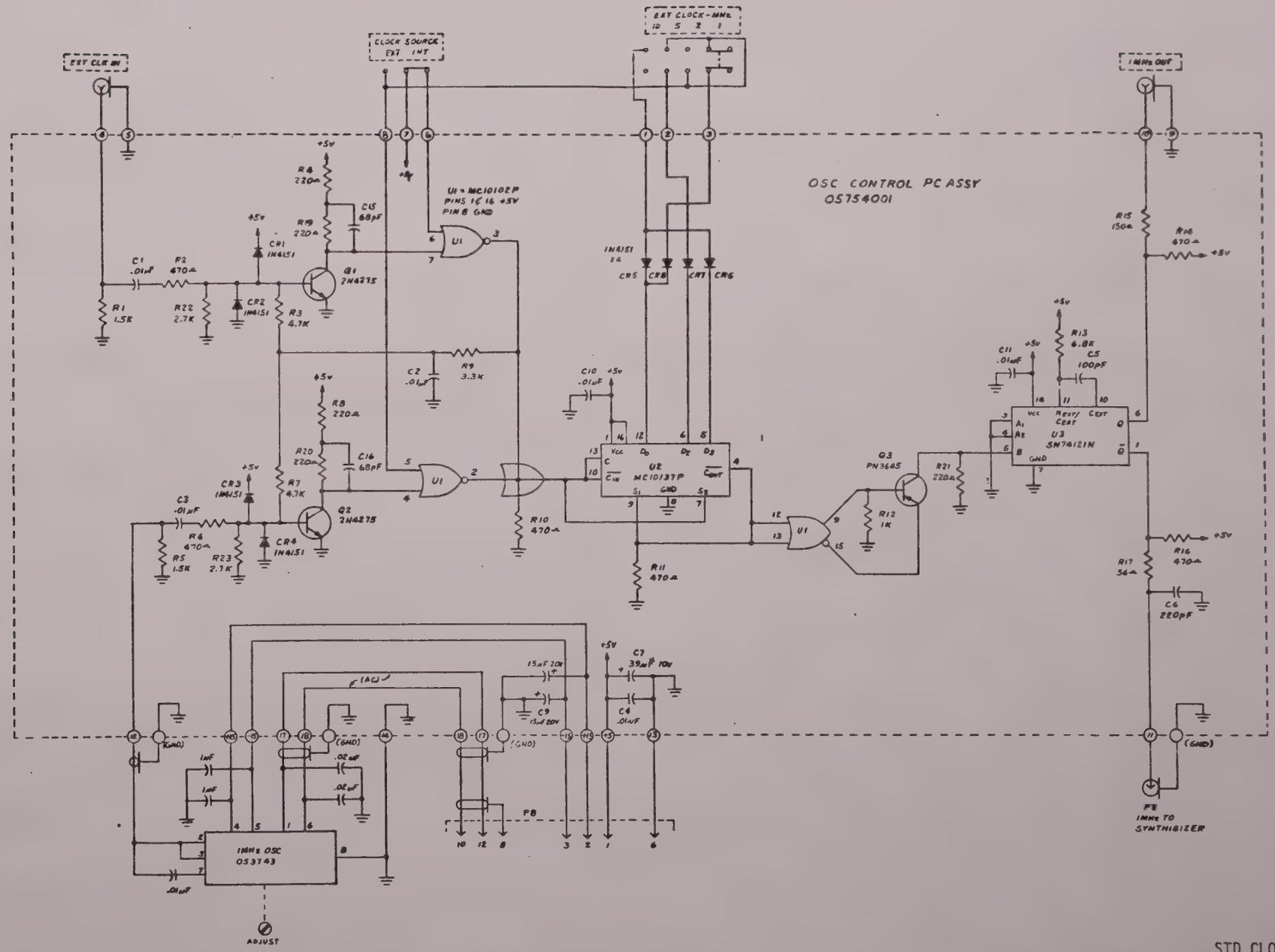


FIGURE 7-53
STD CLOCK OSCILLATOR (A5)
SCHEMATIC DIAGRAM #05756001 Rev E

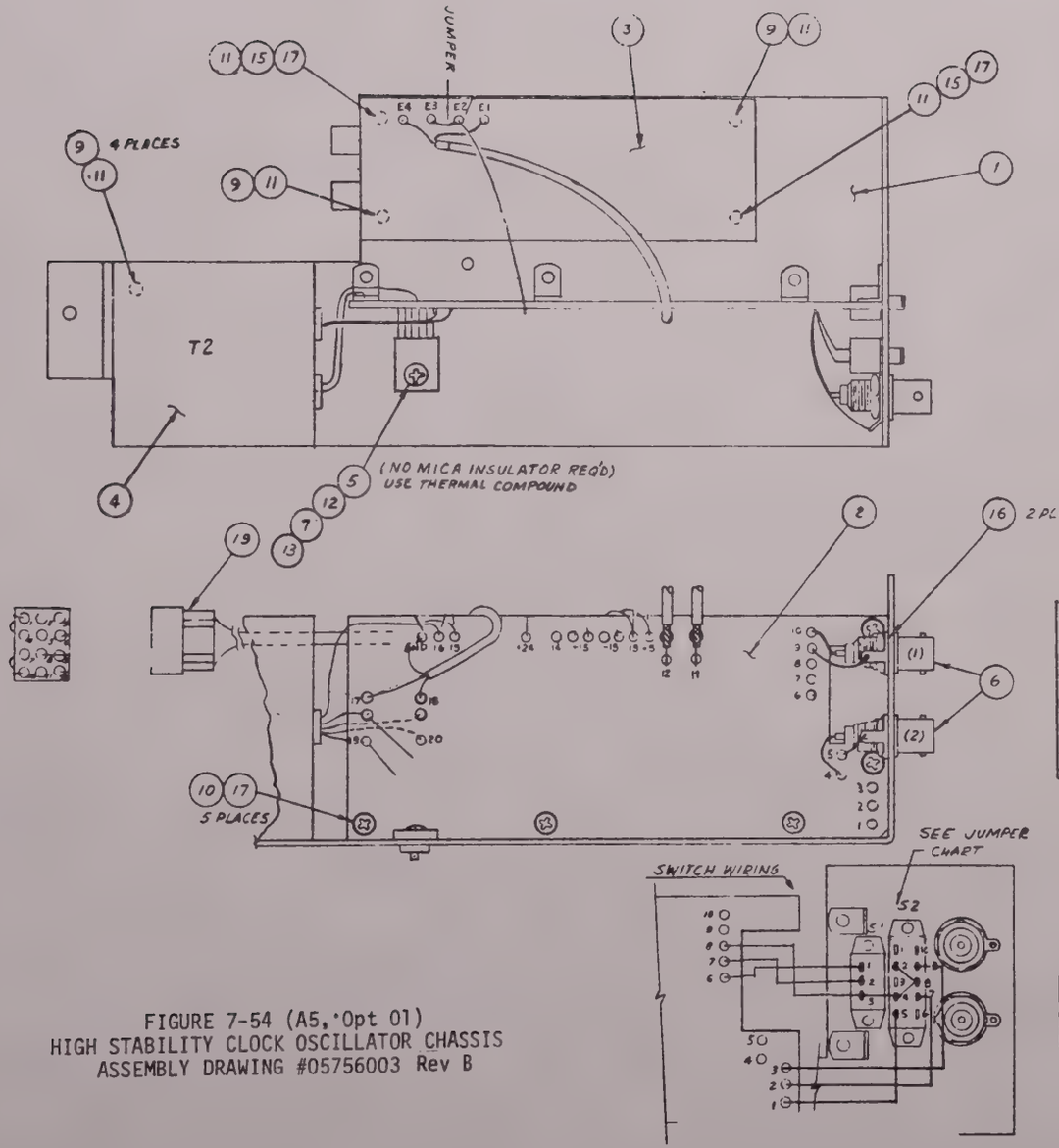


FIGURE 7-54 (A5, Opt 01)
HIGH STABILITY CLOCK OSCILLATOR CHASSIS
ASSEMBLY DRAWING #05756003 Rev B

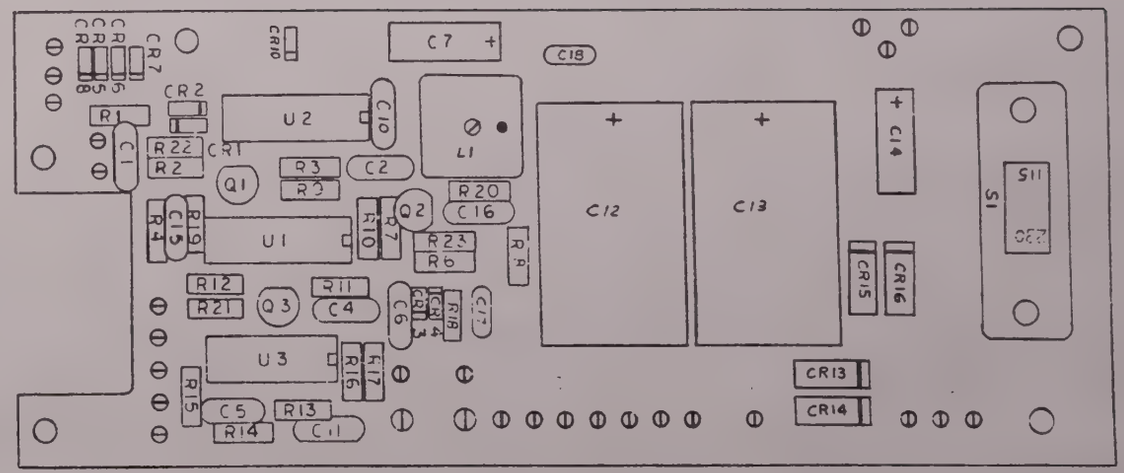


FIGURE 7-55 (A5, Opt 01)
HIGH STABILITY OSCILLATOR CONTROL PCB
ASSEMBLY DRAWING #05754003 Rev A

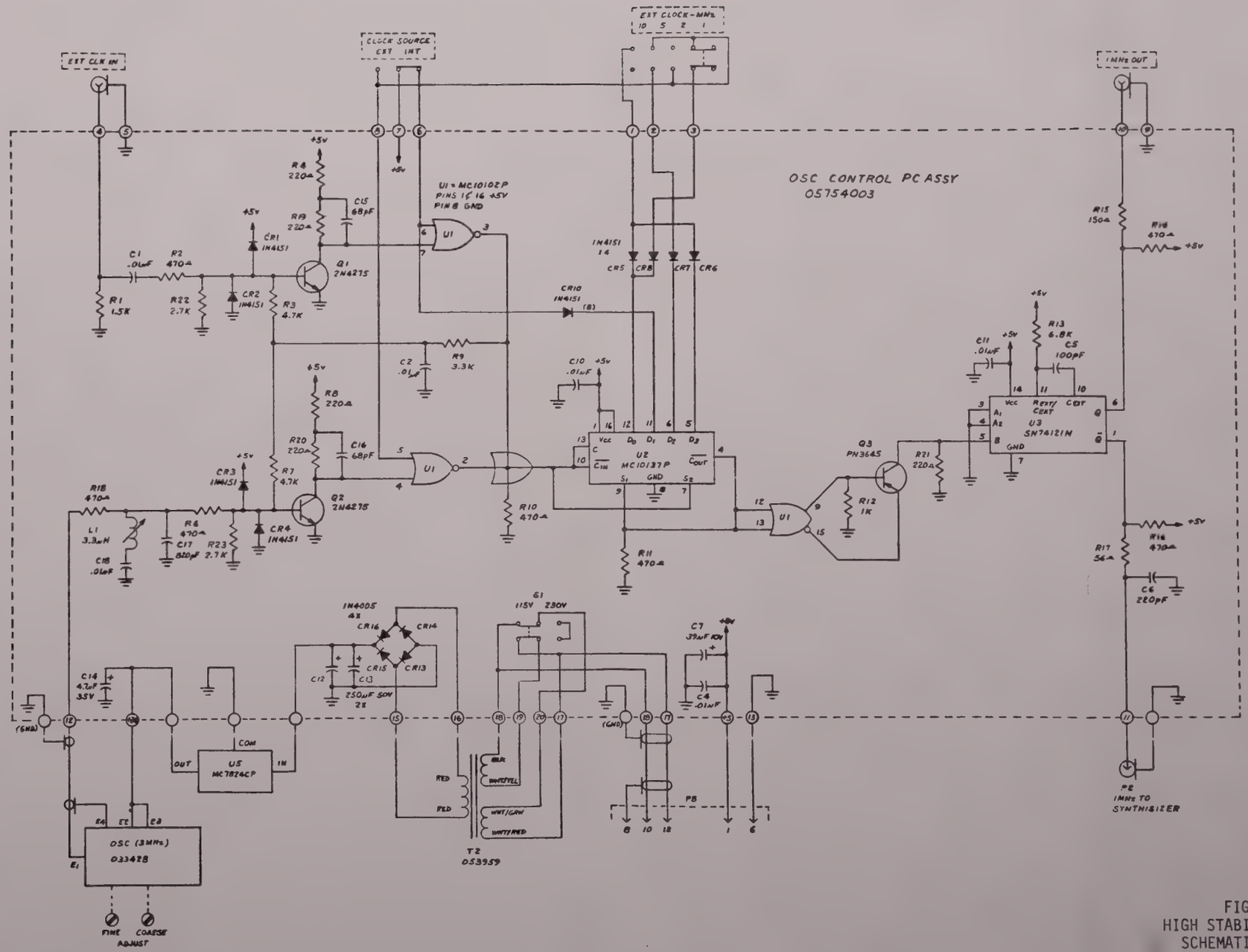


FIGURE 7-56 (A5, Opt 01)
HIGH STABILITY CLOCK OSCILLATOR CHASSIS
SCHEMATIC DIAGRAM #05756003 Rev D

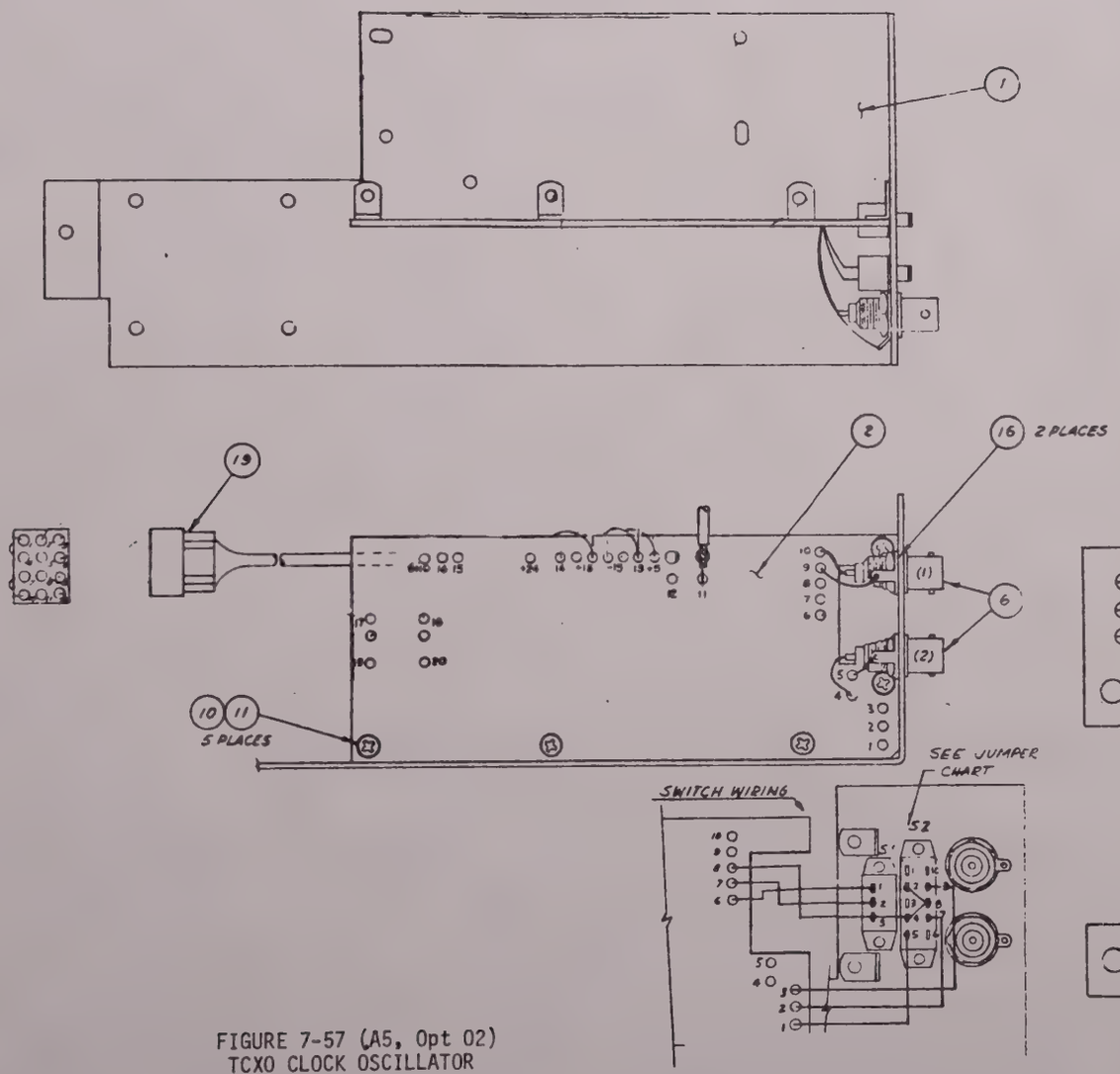


FIGURE 7-57 (A5, Opt 02)
TCXO CLOCK OSCILLATOR
ASSEMBLY DRAWING #05756002 Rev B

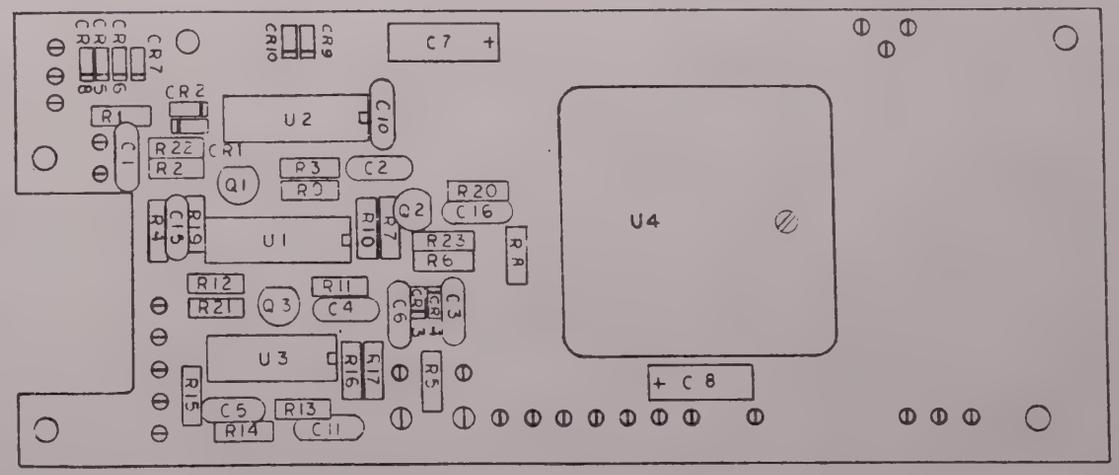


FIGURE 7-58 (A5, Opt 02)
TCXO OSCILLATOR CONTROL PCB
ASSEMBLY DRAWING #05754002 Rev A

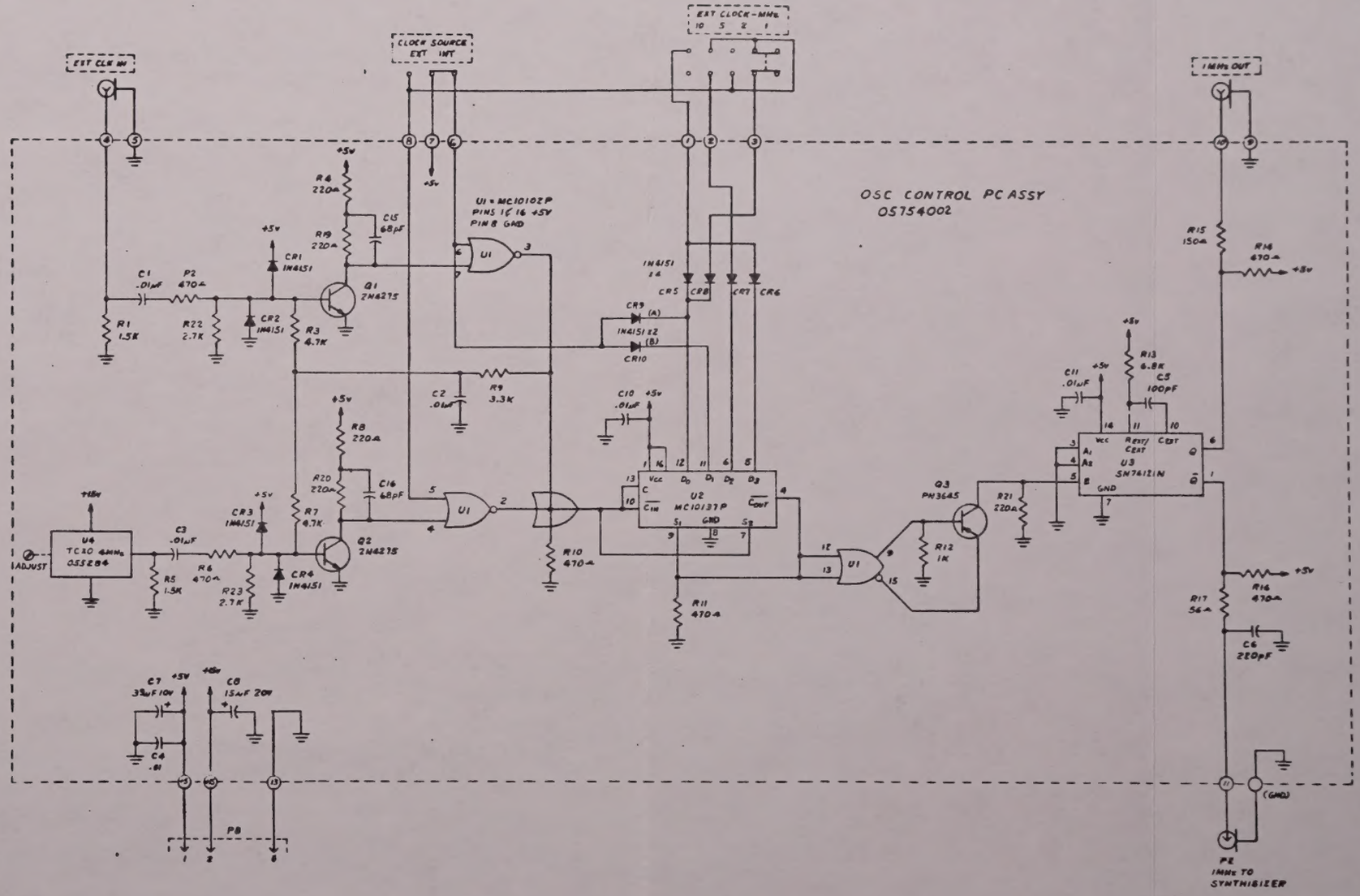


FIGURE 7-59 (A5, Opt 02)
TCXO CLOCK OSCILLATOR
SCHEMATIC DIAGRAM #05756002 Rev D

SIGNAL GENERATOR

68-81069A39-0

MP MASTER
MA36308

56542